AN ANALYSIS OF THE COST EFFECTIVENESS OF A SPECIALIZED MISSION HELICOPTER IN THE U.S. COAST GUARD

N. Edward King

NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

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by

N. Edward King

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Thesis Advisor: R. Nickerson

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The alternatives are analyzed in terms of total differential costs of performing the same missions that were conducted

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It is concluded that it would have been cost effective to have operated specialized mission helicopters during the base period. Projections of future helicopter activity indicate that this advantage would continue into the future.

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by

N. Edward King
Lieutenant Commander, United States Coast Guard
B.S., United States Merchant Marine Academy, 1965

Submitted in partial fulfillment of the
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I. INTRODUCTION

The Coast Guard has long had a policy that its helicopters be able to perform many missions. Its helicopters are, therefore, quite sophisticated and expensive, and the multi-mission capability has contributed substantially to overall effectiveness.

Many missions performed by Coast Guard helicopters require no special equipment other than a platform. Such missions made up thirty-four percent of total flight time during the five-year period 1974 through 1978. Analysis of trends of flight missions indicates that these specialized missions will make up forty-two percent by 1993. The frequency and substantial flight time of the specialized missions suggest the possibility that the Coast Guard might effect a considerable dollar savings in the operation of its helicopter fleet by introducing smaller faster specialized helicopters into its fleet.

Studies have been conducted by Coast Guard and civilian groups to evaluate the feasibility of using specialized helicopters, but all of them have addressed single operational situations such as shipboard deployments on fisheries patrols. None, however, have evaluated the cost-saving potential of different helicopter mixes performing specialized missions.

A. OBJECTIVE

This is a study to compare three hypothetical situations in which different mixes of helicopters were applied to missions flown during the 1974-1978 base period. Each mix is shown as an alternative. The study makes an evaluation of costs and benefits that would have occurred had each one of these been in effect during this base period. It is intended that the resulting analysis provide an information base to aid in any Coast Guard decisions regarding helicopter mix changes.

Conditions under which the Coast Guard operates its helicopter fleet have been and are anticipated to be undergoing considerable change. Such things as the capabilities of new machines, maintenance costs, fuel costs, increased use of imported oil, and policies on the use of ocean resources are causing changing demands on the Coast Guard helicopter fleet. The change is only natural and desirable. The fact that the Coast Guard is called upon to increase its services and expand its sphere of operation is an indication of the high level of performance and service that the Coast Guard has been able to provide.

In the effort to be responsive to needs for its services, the Coast Guard must anticipate the needs of the future, both as to what those needs might be and as to how to provide them cost effectively.

The objective of this study is to consider factors which might cause the Coast Guard to re-examine policies

regarding the make-up of its helicopter fleet. No attempt is made to advocate a specific mix of helicopters or manufacturers.

The study addresses four factors which might influence planning for helicopter procurement and operation in the future. These are:

1. The cost factors including initial investment and recurring costs.
2. Future costs such as the effect of fuel price changes on total operating costs.
3. Future missions and expectancies from the Coast Guard.
4. Information which might be gained from experience with contracted services.

B. SCOPE OF THE STUDY

Chapter II provides background information on the description of Coast Guard helicopter operations, missions and the fleet. It is provided essentially to acquaint those not familiar with the Coast Guard with basic information to provide understanding for more detailed material which follows.

The consideration of helicopter mixes for the Coast Guard is addressed in Chapter III. In this chapter, three alternative mixes of helicopters are presented. The conditions of operation are examined extensively so as to provide a realistic comparison between the illustration alternatives. This example uses a five-year base period from 1974 through 1978, comparing flights and costs under two alternatives with

those which actually existed. It considers the choice of helicopters, location bases for helicopters as they relate to missions, and the evaluation of the different alternatives.

A consideration of the future is presented in Chapter IV. It treats the effect on total cost of rising fuel and maintenance costs. It addresses the probability that currently defined activity will increase, and that new types of missions could greatly influence the desired helicopter mix. It also addresses the subject of contracted helicopters.

Summaries, conclusions and recommendations are presented in Chapter V.

II. COAST GUARD AIRCRAFT MISSIONS

The aircraft in the Coast Guard are identified according to each machine's capability in Search and Rescue (SAR). Fixed-wing aircraft fill the search roles primarily, being sub-designated according to their endurance ability: short, medium or long. This leads to designation possiblities such as Short-Range Search (SRS), Medium-Range Search (MRS) and Long-Range Search (LRS). Helicopters fill the recovery role of SAR, leading to corresponding designations of Short-Range Recovery (SRR), Medium-Range Recovery (MRR) and Long-Range Recovery (LRR).

During the base period 1974-78, two helicopters were in service in the Coast Guard. The HH-52A was filling the short-range role. It is basically a single-engine, amphibious helicopter with a maximum gross weight of 8,300 pounds, normal cruise air speed of 86 kts. and crew of two pilots (possibly one) and one crewman. The medium-range role was being filled by the HH-3F helicopter, which is also amphibious, with two engines, maximum gross weight of 22,050 pounds, normal cruise speed of 115 kts. and crew of two pilots and two crewmen. Both of these helicopters are fully instrumented for all-weather operations. They are equipped to perform all Coast Guard missions from delivering de-watering pumps and hoisting injured people aboard to carrying up to five passengers in the HH-52A (solo pilot) or eight passengers in the HH-3F on transport or surveillance flights.

Appendix E shows in tabular form the number and purpose of all missions flown by Coast Guard helicopters during the 1974-78 period from each base of operations. Examination of Appendix E shows that Coast Guard helicopters are called upon to perform in a wide variety of roles in the course of a year. The Abstract of Operations, Aircraft, requires statistics be kept on twenty-one categories of flight. For the purposes of this analysis, the missions flown by each aircraft at each station were grouped into twelve categories. Appendix E shows flights under each category.

Each category was then examined to determine the percentage of flight time which might be flown by specialized helicopters. Table I breaks down the flight time in each category which might be flown by special mission and by multi-mission helicopters. Following are descriptions of each flight category with the percentage of total flight time which might be performed by special mission craft.

Search and Rescue:

This includes all operations involved in searching for, and rescuing of, personnel and/or property in distress. It requires an aircraft capable of instrument flight, considerable endurance, hoist operations, suitable inside dimensions, and weight lifting capacity for carrying several possibly injured people.

Multi-mission helicopters are required for all search and rescue flights. Therefore, the percentage assigned to special mission helicopters in Table I is 0.

General Surveillance:

Missions include Domestic Ice Surveillance, Bridge Administration, Port Security and Boating Safety, along with Cadet/OC and Reserve Training. The non-training missions require an aircraft capable of operating in

and around harbors, possibly carrying one or two observers in addition to the basic crew. The training flights are orientation flights to introduce prospective personnel to Coast Guard aviation. Nothing is required of the aircraft beyond transport capabilities.

All missions under this category can be performed by special mission helicopter. The percentage shown in Table I is 100.

Law Enforcement:

A surveillance platform to observe and search for possible violators of fishery, customs, or other federal or international laws is needed. A medium to high level of endurance is required of the helicopter as well as the capability for significant levels of operations deployed aboard ship. The helicopters are limited in their operations by their ability to navigate independently from the ship or survive a possible ditching until the ship arrives.

All law enforcement missions could be performed by special mission helicopters. Therefore, the percentage shown in Table I is 100.

Marine Pollution:

This category requires a surveillance platform to observe and search for possible violations of anti-water pollution regulations. The operations include harbors and inshore areas as well as offshore patrols. Short to medium levels of endurance are required.

All marine pollution missions could be performed by special helicopter. Therefore, the percentage shown in Table I is 100.

Aid to Navigation:

This category requires the ability to transport personnel to various aids to navigation devices for periodic and unscheduled maintenance. A level of IFR capability may be required. An external cargo hook may be required to carry outsized items or to actually place a device, such as a tower or antenna, on station.

Approximately one half of the aids to navigation flights require the capabilities of a multi-mission helicopter. The other 50% could be flown by special mission craft. Therefore, 50% are shown in Table I to be for special mission helicopters.

Operational Training:

This category is for training of both the pilots and crewmen. It must be carried out in the same model craft in which the individual requires particular training. That is, training in one type of aircraft will not suffice for training requirements of another. To maintain qualification in any type of aircraft, the individual must meet certain minimum requirements of flight time in that aircraft.

Table I percentage reflects the composite percentage distribution of all categories.

Cooperation with Other Agencies:

Operations with and for agencies other than the Coast Guard make up this category. These are normally of a transportation nature and require the capacity to carry passengers.

One half of these missions are judged to require multi-mission capability. Therefore, the percentage shown in Table I is 50.

Polar Service:

All ice breakers require helicopters while they are deployed on polar operations. The helicopter missions aboard the ships are primarily of a support nature -- finding leads in the ice, transporting personnel, etc. These helicopters require independent navigation capabilities and survivability features for extended periods of time. External load capabilities are often required. Although the rescue hoist is rarely needed for SAR, there could be a use for the hoist on routine personnel deliveries.

All polar service flights could be performed by special mission craft. The percentage in Table I is therefore 100.

Administrative:

This category includes rapid transport of staff personnel and VIP's between points of difficult accessability. The mission requires passenger carrying capabilities and short to medium range in the helicopter. The ability to operate in instrument conditions would be a low-priority requirement.

All missions could use the special mission helicopter. The percentage of 100 is shown in Table I.

Test Flights:

Functional check flights which are performed after routine and unscheduled maintenance make up this category. The number of sorties/flight hours would be a function of number of aircraft assigned and amount of maintenance work required on each.

The percentage shown in Table I is a reflection of the ultimate helicopter mix.

Ferry Flights:

This category of operation is credited with the flight time required to fly the aircraft to and from an overhaul facility. These flight hours would be a function of the distance the unit was from the facility.

Ten percent of total ferry flight time is allocated to special mission helicopters because maintenance facilities for the simpler helicopters are more numerous and, therefore, not as far away.

Miscellaneous Operations:

This category includes Radio Navigation, Military Operations, Military Preparedness, Proficiency Training, and Oceanography. Combined, these missions comprise only 1% of the total helicopter flight time during the base period. A helicopter capable of the entire scope of Coast Guard missions is required.

The percentage in Table I is therefore 0 for special craft.

TABLE I

Distribution of Flight Time between

Specialized and Multi-mission Helicopters

Flight Category	Flight Time Percent	
	Multi-mission	Special Mission
Search and Rescue	100	0
General Surveillance	0	100
Law Enforcement	0	100
Marine Pollution	0	100
Aids to Navigation	50	50
Operation Training	--	--
Cooperation with Other Agencies	50	50
Polar	0	100
Administrative	0	100
Test	--	--
Ferry	90	10
Miscellaneous	100	0

III. THE EFFECT OF HELICOPTER MIX ON TOTAL MISSION COST

A wide variety of helicopters is available for use by the Coast Guard for its missions. As helicopters are manufactured to accomplish different things under different conditions, it may be assumed that some of the various machines might be suitable or advantageous to perform Coast Guard missions. This chapter identifies types of helicopter missions flown from each Coast Guard air station, indicating which ones might be performed by special mission helicopters (SMH). It makes a cost comparison between the following three possible helicopter mix alternatives.

1. The Present Mix

   All helicopters in use during the 1974-78 period were multi-mission helicopters (MMH).

2. Multi-mission and Light Observation Helicopters

   With this mix the multi-mission helicopters would be used primarily for search and rescue, and the light observation helicopters for marine pollution types of missions.

3. A Mix of Multi-mission, Light Observation, and Medium Observation Helicopters

   The medium observation helicopter would be included primarily for shipboard/law enforcement work.

Note 1: A modification of #2, later to be described, might be considered as a fourth alternate.

Note 2: Both the Light Observation Helicopters (LOH) and the Medium Observation Helicopters (MOH) are Special Mission Helicopters (SMH).

The author emphasizes that the purpose of the comparison is not to claim that the helicopters used are those which the Coast Guard should choose. Rather the purpose is to indicate that monetary gains might be attained by a mix including specialized mission helicopters.

The chapter is in four parts. Part A describes helicopters available at the time of the 1974-78 base period and provides reasons for the helicopter selection.

Part B provides a rather complete study of missions flown by the Coast Guard during the base period, identifying those flights which would have been flown by specialized mission helicopters if they had been available. Part B thus provides the mixture of flight data upon which the comparison is made. It makes possible the assignment of SMH helicopters to Coast Guard stations for the 1974-78 period.

Part C compares the alternatives.

Part D considers a Short-Range Recovery (SRR) replacement for the H-52A.

A. SELECTION OF SPECIALIZED MISSION HELICOPTERS

Table II gives a summary of helicopters available at the time of the base period and considered for the comparative study. Small two-engine helicopters as suitable machines have only recently been available in large numbers. However, the Messerschmitt-Bolkow-Blohm (MBB) BO-105 began its flight tests in 1967 and was available during the base period.

TABLE II

CHARACTERISTICS OF HELICOPTERS CONSIDERED FOR THIS STUDY

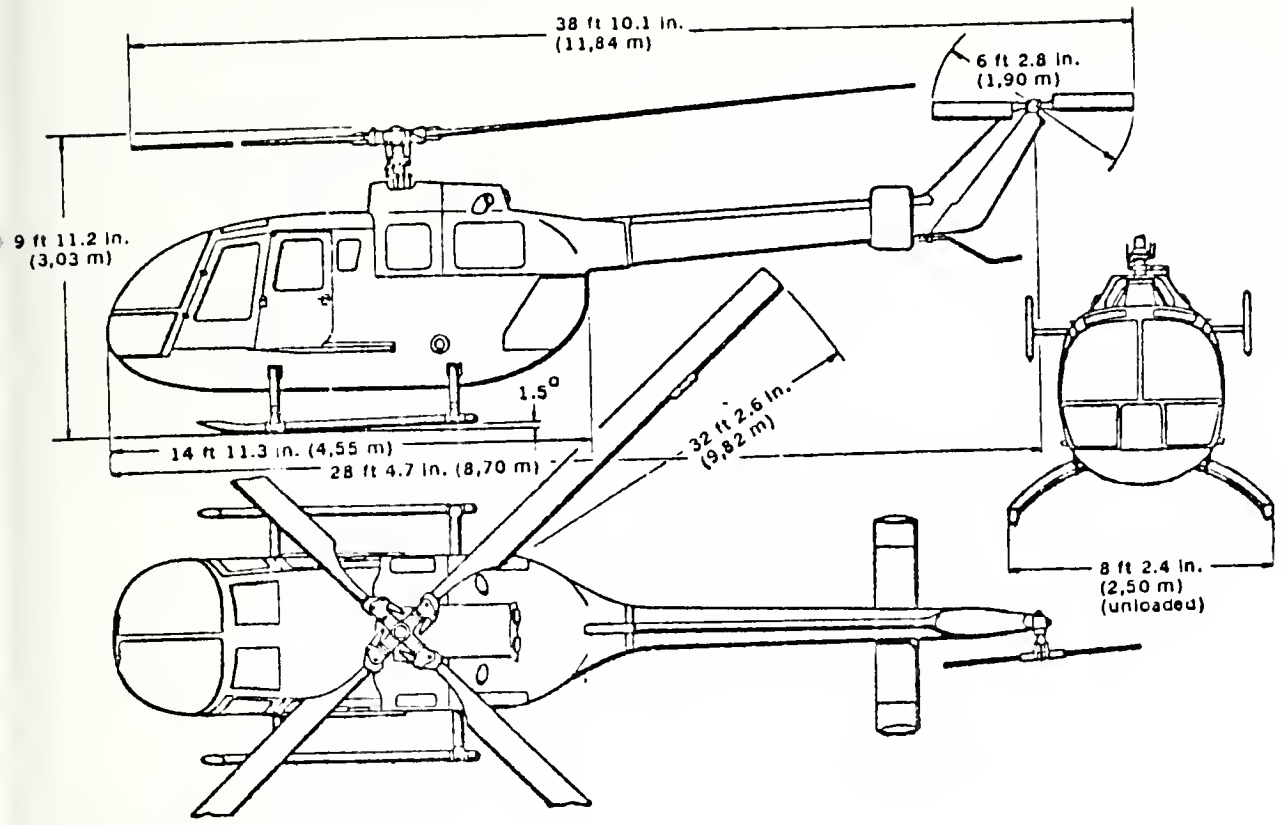
Helicopter Models	Max. Gross Weight	Useful Wt. W/Fuel	Max Ext. Load	Normal Cruise Kts.	Fuel Consump. GPH	Range SM	Max. End.	Seats	Basic Price Thousands of 1979 Dollars
SINGLE ENGINE									
Robinson R22	1300	402	--	86	8.3	240	2.7	2	40
Hughes 300	2150	924	900	72	10	225	3.5	3	76
Spitfire Mark II	2500	720	1400	96	25	308	4.0	4	110
Hughes 500D	3000	1235	2065	111	26	350	3.5	5-7	227
Bell 206B	3200	1126	1500	106	26	341	2.9	5	225
Aerospatiale 341G	3970	1017	1540	113	45	405	3.75	5	314
Aerospatiale 350D	4190	1006	1650	103	36	491	5.1	6	335
Aerospatiale 318C	3650	1660	1322	78	34	430	5.3	5	
DUAL ENGINE									
Boeing B0105	5070	1255	1984	117	53	350	3.4	5	649.5
Spitfire Taurus II	7400	966	1600	82	74	360	3.0	9	550
Agusta 109A	5400	1141	2000	120	55	415	3.3	6-8	947
PRESENTLY IN SERVICE									
H-52A	8300	2200	3000	86	61	300	3.5	6	400
HH-3F	22050	7500	8000	115	182	850	6.0	9-12	1,670

Largely for this reason, the MBB BO-105 was selected to be the MOH for this analysis. The BO-105 is manufactured in West Germany and is marketed and supported in North America by Boeing Vertol. Its characteristics are outlined in Figure 1. The electronic and associated costs in 1979 dollars included in the MBB BO-109 are:

ADF	$1300
VHF	4650
VHF Nav	4370
HF	2050
FM	2050
Transponder	1700
ELT	350
UHF	5500
RadAlt	4800
	$26770

Selection of the Light Observation Helicopter was more difficult. Both the Bell 206 and Hughes 500 are smaller and lighter than the multi-mission helicopters in use. (See Figures 4 and 5). Comparable equipped, the Bell was $2060 less expensive than the Hughes in 1974 dollars, but operating costs were found to be $4.85/hour more expensive. The investment favors the Hughes after 425 flight hours. The Bell has slightly greater endurance because of its larger standard fuel capacity (307 compared to 294 nautical miles). Airspeeds are comparable at normal cruise and the seating capacities are the same. Therefore, in view of the operating costs advantage enjoyed by the Hughes 500, it was selected as the LOH for this analysis.

MESSERSCHMITT-BOLKOW-BLOHM BO-105



Max. Gross Wt.	5070 lbs.	List Price[2]	$450,000
Useful Wt.[1]	900 lbs.	Floats	28,220
Max. Ext. Load	1984 lbs.	Ext. Hook	5,750
Max Cont. Cruise	146 Kts.	Avionics	26,770
Normal Cruise	117 Kts.	Fire Extinguishers	4,700
Normal Fuel Cons.	53 Gal/hr.	Misc.	1,740
Normal Range	338 NM	Total Price	$517,180
Normal Endurance	2.9 Hr.	Local Maint.	.9 MHr/flt.hr.
Seat (Including Pilot)	5	Local Parts	$16.75/flt.hr.
		Parts Support	$ 3.35/flt.hr.
		Over Haul	$82.50/flt.hr.

[1] Assuming all CG equipment and max fuel on board.

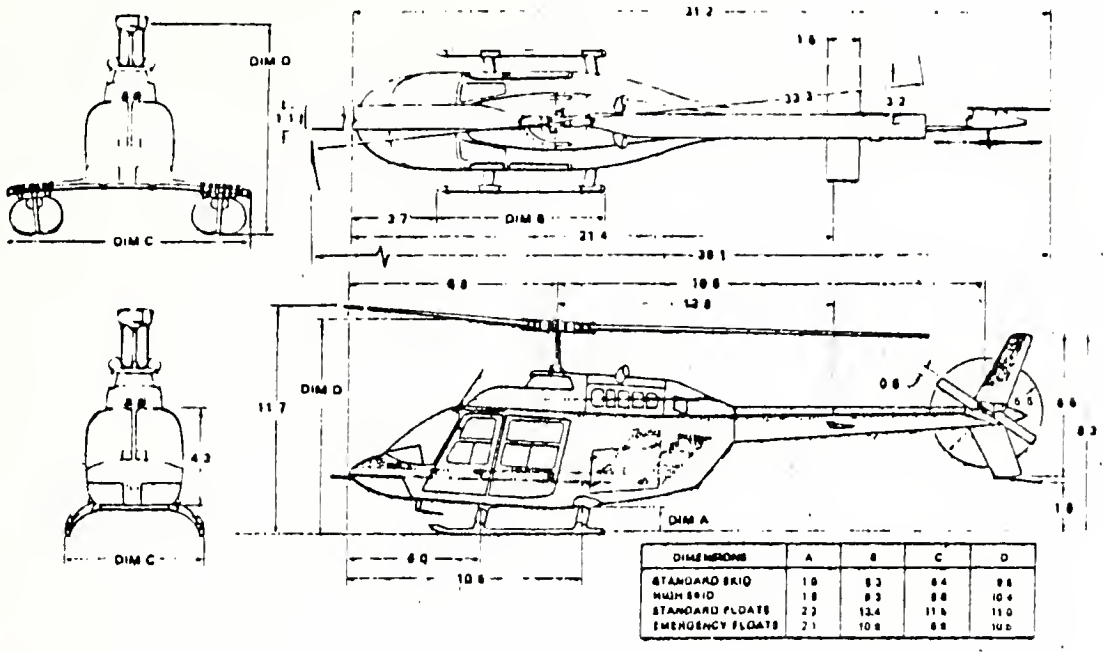
[2] 1973 dollars

Source: Manufacturers' brochures

Figure 1

Characteristics of the MMB BO-105, the helicopter selected as the Medium Observation Helicopter for this study

BELL 206

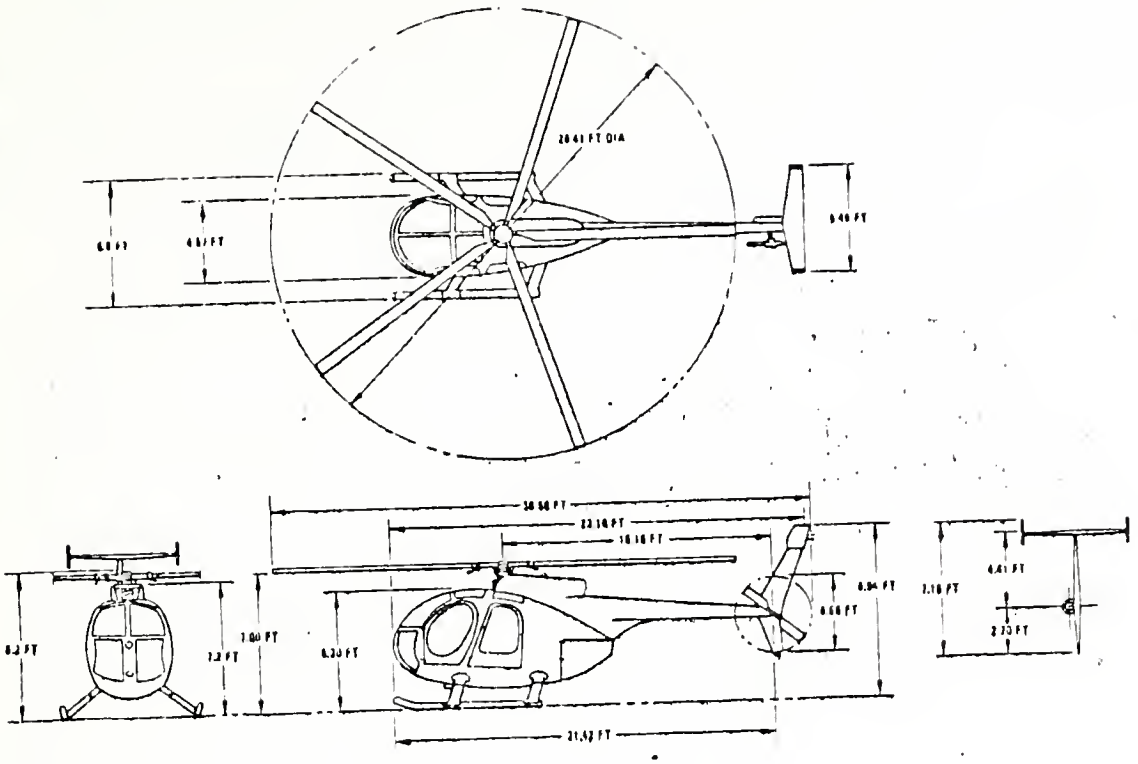


Max. Gross Wt.			Basic Price	$165,300
Normal	3200	lbs.	Floats	12,000
w/Ext. Load	3350	lbs.	Price	$177,300
Useful Wt.(1)	920	lbs.		
Max. Ext. Load	1500	lbs.	Local Maint.	.4M.H./flt.Hr.
Max. Cont. Cruise	133	Kts.	Local Parts	$ 7.00/flt.hr.
Normal Cruise	106	Kts.	Parts Support	$ 1.40/flt.hr.
Fuel Consumption	26	gal/hr	Over Haul	$27.25/flt.hr.
Normal Range	307	NM		
Normal Endurance	2.9	hr		
Seats (including Pilot	5			

(1) Assuming all CG equipment and max. fuel on board
(2) 1973 dollars
Source: Manufacturers' brochure

Figure 2
Characteristics of the Bell 206, one of two light observation helicopters considered for this study

HUGHES 500



Max. Gross Wt.		Basic Price(2)	$166,700
Normal	3000 lbs.	Floats	13,660
w/ext.Load	3550 lbs.		
Useful Wt.(1)	1005 lbs.	Total Price	$179,360
Max. Ext. Load	2065 lbs.		
Max. Cont. Cruise	139 Kts.		
Normal Cruise	111 Kts.	Local Maint.	.3 M.N./flt.hr.
Fuel Consumption	26 gal/hr.	Local Parts	$ 9.00/flt.hr.
Normal Range	273 NM	Parts Support	$ 1.80/flt.hr.
Normal Endurance	2.5 hr.	Over Haul	$20.00/flt.hr.
Seats (including Pilot)	5		

(1) Assuming all CG equipment and max. fuel on board.

(2) 1973 dollars

Source: Manufacturers' brochure

Figure 3

Characteristics of the Hughes 500, one of two light observation helicopters considered for this study; it was the final choice.

The prices in Table II are 1979 prices. For the purpose of this analysis, these were discounted back to 1974 levels to determine the prices, at that time, of the helicopters and equipment assumed to be included in each SMH. This explains differences between values in Table II and Figures 1 - 3. The operating costs were derived by the manufacturers from experiences over the years since introduction of each model [Refs. 2, 3, and 26]. Therefore, the operating costs are characteristic of the actual costs expected during the base period.

B. ALLOCATION OF SPECIALIZED MISSION HELICOPTERS

For purposes of this study, the Specialized Mission Helicopters were distributed according to the flight activity at various bases during the 1974-78 period. Factors considered were:

1. Petroleum shipping in the area;
2. Law enforcement flights;
3. Polar operations;
4. Availability of contract overhaul.

Table III shows the allocation to each station. The allocation for each station is in addition to helicopters already located there unless there were more MMH helicopters already there than normally needed for prescribed Search and Rescue response.

Stations located near ports experiencing large volumes of petroleum-carrying tanker traffic are expected to patrol

TABLE III

ASSIGNMENT OF SPECIALIZED MISSION HELICOPTERS

TO DIFFERENT AIR STATIONS

Station	Numbers of Assigned Helicopters		
	Marine Patrol	Law Enforcement	Totals
Cape Cod	2	2	4
Brooklyn	2	1	3
Cape May	2		2
Eliz City	2	1	3
Savannah			
Miami		1	1
St. Petersburg	1		1
Puerto Rico*		1	1
Houston	2		2
Corpus Christi			
New Orleans	2		2
Detroit			
Traverse City			
Chicago			
San Diego		1	1
Los Angeles	2		2
San Francisco		1	1
Arcata			
Port Angeles	2	1	3
Astoria		1	1
North Bend			
Barbers Point*			
Kodiak*		1	1
Sitka/Annette		1	1
Mobile (Polar)	—	12	12
Totals	17	24	41

*Contract overhaul is not available at these stations.

these areas often, looking for possible oil spills (Marine Pollution Missions). The greater the volume of traffic, the more frequent would be the required patrols. A factor of one additional flight per week for every increment of 10 million tons per year above a base of 10 million tons of petroleum handled by the port has been used as a criterion for planning these flights [Ref. 7]. Table IV indicates the total tons of petroleum transiting major U.S. ports. Specialized mission helicopters were placed at adjacent air stations according to the following:

0 SMH when less than 5 m tons/year

1 SMH when total between 5 and 10 m tons/year

2 SMH when total is greater than 10 m tons/year.

Table IV depicts the air stations adjacent to these ports, and SMH assignments based upon this MP criterion are found in Table III.

1. Law Enforcement Activity (LE)

Patrols are also flown for drug interdiction and fisheries conservation. Determination of the Law Enforcement flight time and appropriate Specialized Mission Helicopter assignment was made from law enforcement flights made from different bases. These flights are shown in Appendix E. Appendix E is voluminous. It is included here because data presented is difficult to compile and is not otherwise available in tabular form. Further, the data noted for 1977 is the result of converting actual fifteen-month data into twelve-month equivalent for future projections of flight activity.

TABLE IV

PETROLEUM SHIPPING ACTIVITY IN MAJOR U.S. PORTS

Petroleum Shipping Ports	Imports Crude & Refined Products Tons x 10^3	Exports Crude & Refined Products Tons x 10^3	Total Tons x 10^3
Portland, ME-Cape Cod	2,706.666	--	2,706
Boston-Cape Cod	8,560	1,175	9,735
L.I. Sound Providence, New London New Haven-Brooklyn	11,293.333	1,363	12,656.333
New York & Vicinity	41,026.666	49,134	90,160.666
Deleware Bay-Cape May Philadelphia, Wilmington	47,213.333	23,568	70,781.333
Chesapeake Bay Baltimore, Norfolk Hampton Roads-E. City	13,946.666	7,776	21,722.666
Savannah/Charleston	3,693.333	1,117	4,810.333
Miami	3,173.333	--	3,173.333
Tampa-St. Pete	6,400	--	6,400
Mobile	1,920	--	1,920
New Orleans	17,800	--	17,800
Houston/Galveston Corpus Christi	34,333.333	7,528	41,861.333
Port Arthur-Houston	14,080	--	14,080
San Diego	160	--	160
Los Angeles	26,186.666	1,216	27,402.666
San Francisco	720	4,200	4,920
Columbia River-Astoria Portland, Willamete R.	360	1,434	1,794
Straits of Juan DeFuca Seattle-Port Angeles	8,680	2,194	10,874
S.E. Alaska, Anchorage	560	388	948
Honolulu	3,720	--	3,720

SOURCE: National Energy Transportation Volume I - Current Systems & Movements; Pub. No. 95-15, pgs. 315-330.

This data is used to determine the volume of petroleum activity near each air station for placement of Specialized Mission Helicopters.

A factor was needed to convert H-3 hours into H-52 hours. It was assumed by the Office of Operations Plans and Programs Staff, in their analysis of Coast Guard requirements for replacement of SRR helicopters, that from 15% to 30% of the flight time of surveillance missions would be spent investigating sightings, while the remainder would be at cruise speed [Ref. 23]. For the 115 Kt. H-3 and 86 Kt. H-52, this produced factors of:

$$.85\ (115 \div 86) + .15 = 1.29$$

$$.7\ \ (115 \div 86) + .30 = 1.23$$

An average factor of 1 H-3 hour = 1.26 H-52 hour is used for this conversion before entering the data from Appendix E into Table V.

After 1973, the ship/helo team concept was implemented in LE patrols. This meant that whenever a ship was on an LE patrol, it had a helicopter embarked or standing by ashore to assist should it be needed to locate or pursue a suspected violator. The prospect of this increase in activity was known in 1973, providing for the ability to place the specialized mission helicopters. The LE mission warrants assignment of one SMH if LE hours flown by a particular station are greater than the overall Coast Guard median. Two SMH's are warranted if the station flies a significantly higher number of LE hours than the rest of the Coast Guard stations.

Two helicopters are embarked upon each ice breaker while she is deployed to polar operations. There were six ice breakers at the beginning of the base period. The twelve

TABLE V

ALLOCATION OF SPECIALIZED MISSION HELICOPTERS
FOR LAW ENFORCEMENT PATROLS

Coast Guard Air Station	Flight Hours H-3 (Converted)	+ H-52	= Total	Numbers of Helicopters
Cape Cod	84	542	626	2
Brooklyn	62	1	63	1
Cape May			0	
Elizabeth City		11	11	1
Savannah			0	
Miami		158	158	1
St. Petersburg	1		1	
Puerto Rico	16	5	21	
Houston		5	5	
Corpus Christi		1	1	
New Orleans	8		8	
Detroit			0	
Traverse City			0	
Chicago			0	
San Diego	15		15	1
Los Angeles		3	3	
San Francisco		9	9	1
Port Angeles		49	49	1
Astoria	35	41	76	1
Barbers Pt.			0	
Annette	195		195	1
Kodiak	123	65	188	1
Totals	539	890	1429	11

Note 1. Polar flights are not included.
2. Numbers of helicopters shown here are included in Table III.

SOURCE: Abstract of Operations, Aircraft FY-73

This data is used to determine the Law Enforcement patrol activity of each air station for placement of Specialized Mission Helicopters.

helicopters required to support this mission were assigned from the Aviation Training Center, Mobile, Alabama.

The final criterion for placement of the SMH was that the air station receiving the helicopter be close to a manufacturer's authorized overhaul facility. "Close to" was accepted to mean within one day's travel or six hours' flight time. The limit is thus approximately 700 miles to the nearest overhaul facility. Table VI lists the closest overhaul facility to each station, for each type of SMH, and the distance in miles between them. All stations are within overhaul distance except Puerto Rico, Barbers Point and Kodiak.

The preceding shows the placement of 41 specialized mission helicopters at fifteen air stations. When both types of SMH are added to the station, the LOH addition is based upon Marine Pollution patrol needs, and the MOH on Law Enforcement and Polar needs. Marine Patrol missions are primarily flown over harbors and inshore waterways while Law Enforcement and Polar flights are generally offshore.

C. COST COMPARISON BETWEEN THE ALTERNATIVES

Each of the alternatives was examined under the following Life Cycle Cost Model.

LIFE CYCLE COST MODEL

1. Initial Purchase Price - fly-away cost
   - Avionics
   - Floats and Hook
   - Training for 1 pilot and 1 mechanic

2. Non-Recurring Initial Investment
   - TAD for initial pilot and mechanic training

TABLE VI

DISTANCES TO OVERHAUL FACILITIES

FROM COAST GUARD AIR STATIONS

Station	Nearest Plant			
	Hughes - Miles		Boeing - Miles	
Cape Cod	Bedford	- 20	N.Y. City	-180
Brooklyn	Garden City	- 10	N.Y. City	- 5
Cape May	West Trenton	- 10	Wilmington, Del	- 90
Elizabeth City	Washington, D.C.	-200	Roanoke, Va.	-180
Savannah	Jacksonville, Fla	-110	Roanoke, Va.	-350
Miami	Ft. Lauderdale	- 30	Palm Beach	- 70
St. Petersburg	Ft. Lauderdale	-180	Orlando	-100
Puerto Rico	Ft. Lauderdale	-875	Orlando	-900
Houston	Houston	- 5	Houston	- 5
Corpus Christi	Sabine Pass	-250	Houston	-190
New Orleans	Sabine Pass	-250	New Orleans	- 5
Detroit	Linden	-150	Roanoke, Va.	-460
Traverse City	Linden	-120	Roanoke, Va.	-660
Chicago	Madison, Wisc.	-125	Roanoke, Va.	-680
San Diego	Carlsbad	- 20	Van Nuys	-125
Los Angeles	Torrance	- 10	Van Nuys	- 25
San Francsico	San Jose	- 20	Van Nuys	-370
Port Angeles	Bellingham	- 95	Seattle	- 90
Astoria	Seattle, Wash.	-140	Portland	- 95
Barbers Point	Seattle, Wash.	-2330	Seattle, Wash.	-2409
Annette	Ketchikan	- 30	Seattle, Wash.	-659
Kodiak	Ketchikan	-742	Seattle, Wash.	-1258
Mobile	Atlanta	-330	New Orleans	-150

SOURCES: Manufacturers' Service Directories and Interview with Manufacturers

- Initial procurement of GSE
- Initial supply of spare parts

3. Recurring Costs
   A. Operating Costs
      - Fuel and Oil/flight hour
      - Local man hours of maintenance/flight hour
      - Local supply of parts/flight hour
      - Support of local parts/flight hour
      - Overhaul costs/flight hour

   B. Ground Support Equipment Replacement
      - Depreciation of GSE allowed for replacement

   C. Ongoing crew training
      - Travel and TAD for pilots
      - Contract with civilian school for pilot training

Initial purchase price and non-recurring investments have already been expended for alternative 1. The addition of SMH under alternatives 2 or 3 would not cause additions to alternative 1. For this reason, alternatives 2 and 3 would bear all costs shown in the cost model, and these costs should be compared against the recurring costs for alternative 1, the helicopter fleet actually in existence during the base period.

1. Alternative 1, The Present Helicopter Mix

In this alternative, the recurring costs to the stations qualifying for SMH's in subsequent alternatives are determined. Inasmuch as the current level of GSE replacement and personnel training for MMH continue in all situations, only the Operating Costs are considered to be differential. The costs of parts used locally for the SMH and the supply costs to procure and issue them are included. No dollar value is assigned to the man hours required for maintenance at the local level, as this is not considered differential between the alternatives.

Benefits in this area should be evaluated on a non-monetary basis.

The operating costs were developed in much the same manner used by the Aviation Branch of the Office of Operations at Coast Guard Headquarters, G-OSR-2, in determining the incremental costs used for charging the various Coast Guard programs for missions flown by the service's aircraft. The model used there, however, includes elements of station support costs that are not associated with aviation and therefore not considered differential in this analysis. The element "OG-30/41 Cost per Hour" is representative of costs of parts at the local level maintenance of the aircraft, and is therefore included in this analysis. These costs are:

H-3: $56/hour

H-52: $23/hour [Ref. 33].

The usual source of fuel at these air stations is the Navy or civilian contract. During the base period, fuel prices increased 34%, from $.33/gallon to $.44/gallon [Ref. 35]. A yearly average of $.372/gallon is used for this analysis. The fuel cost per hour for the MMH's was derived by multiplying the rate in pounds per hour by an average factor of 6.6 pounds per gallon of jet fuel times this average cost of $.372/gallon,

H-3: 182 gal/hr X $.372/gal - $67.70/hr

H-52: 61 gal/hr X $.372/gal = $22.69/hr.

The differential overhaul costs were determined by dividing the average AR&SC overhaul costs for each model of

helicopter by the number of flight hours between overhauls. The FY 1978 figures are [Ref. 34]:

H-3: $291,564 ÷ 1900 hr = $153.45/hr.

H-52: $122,197 ÷ 1400 hr = $ 87.28/hr.

In order to achieve a more representative figure for the five-year period, these figures were deflated at an average inflation rate of 10% back to the levels of the midpoint of the period. The average overhaul figures used are:

H-3: $120.92/hr.

H-52: $ 68.78/hr.

These three costs, fuel, local parts and overhead, make up the total differential operating costs for the helicopters. These are summarized in Table VII.

The total differential costs of this alternative are determined by multiplying the total differential operating costs of each helicopter by the hours flown, Tables VII and VIII.

H-3: $244.62/hr X 76,542 hr = $18,724,000

H-52: $114.47/hr X 94,301 hr = $10,795,000

Total Differential Costs of this alternative = $29,519,000

2. Alternative 2, The Mix of MMH and Light Observation Helicopters (LOH)

Alternative 2 would require the procurement of 39 Light Observation Helicopters. For this reason there would be considerable investment in purchase price and non-recurring costs. The support information and derivation of costs for Alternative 2 are found in Appendix A. It can be referred

TABLE VII

DIFFERENTIAL OPERATING COSTS
(DOLLARS)

	Helicopter Type			
	H-3	H-52	Hughes 500	MBB BO-105
Fuel	67.70	22.69	9.67	19.72
Local Parts	56.00	23.00	9.00	16.75
Parts Support	--	--	1.80	3.35
Overhaul	120.92	68.78	20.00	82.50
Total Hourly Cost	244.62	114.47	40.47	122.32

Assumptions: (1) Using fuel costs of $.372/gallon.

(2) Support of local parts of MMH not affected by SMH.

(3) Costs include variable costs only.

TABLE VIII

TOTAL HOURS FLOWN BY MMH'S AT SMH CANDIDATE AIR STATIONS (FY 1974-78)

	H-3		H-52	
	Assigned[1]	Hours	Assigned	Hours
Cape Cod	3(1)	8,505	4(1)	9,550
Brooklyn [2]	3(1)	4,260	7(2)	13,189
Cape May			3(1)	9,334
Eliz. City[2]	3(1)	4,289	3(1)	6,295
Miami			5(1)	12,882
St. Petersburg	4(1)	14,707		
Houston			3(1)	9,106
New Orleans	4(2)	12,199		
San Diego	4(2)	11,938		
Los Angeles			3(1)	8,914
San Francisco			4(1)	10,121
Port Angeles			3(1)	10,396
Astoria	3(1)	9,164		
Annette/Sitka	3(1)	11,480		
Mobile (deployed)			10(0)	4,514
	24	76,542	42	94,301

[1] Numbers in parentheses indicate SAR readiness requirements.

[2] H-3's assigned to Brooklyn were transferred to Elizabeth City during the period in exchange for Elizabeth City's H-52's.

Total number of hours actually flown by the 15 air stations identified as candidate locations for the Specialized Mission Helicopters during the data base period.

to by those interested. A summary of Alternative 2 costs is given in Table IX.

3. Alternative 3, The Mix of MMH, Light Observation and Medium Observation Helicopters

Seventeen Light Observation and 22 Medium Observation Helicopters would be purchased for this alternative. The LOH conducted all marine patrol missions and the MOH the law enforcement and Polar missions. Where only one SMH type was assigned to a station, it flew all SMH missions, whether LOH or MOH, except that the LOH flew only the LE hours deployed aboard ship. The MMH performed all SAR and other missions for which the SMH's are not equipped. The MMH's that were replaced by the SMH in alternative 2 were replaced in this alternative as well.

The support information and derivation of costs for alternative 3 are found in Appendix B. A summary of alternative 3 costs is given in Table IX.

4. Alternative 4, A Modification of Alternative 2

This alternative is essentially the same as alternative 2 except that the Light Observation Helicopters would be excluded from shipboard and offshore patrols because of safety limitations of a one-engine helicopter. Costs are analyzed in Appendix D. No comparison is presented in Table IX, however.

The payback period considers only the value of the savings in current dollars. It does not consider the time-value of money by discounting the savings to present values.

TABLE IX

COMPARISON BETWEEN THE THREE ALTERNATIVES
(THOUSANDS OF DOLLARS)

	Alternative		
	#1 MMH Only	#2 MMH + LOH	#3 MMH + LOH + MOH
Purchase Price	--	6,995	14,427
Non-Recurring Cost	--	264	500
Total Investment	--	7,259	14,936
Recurring Costs (5 yr.)			
Operating	29,591	22,890	23,686
GSE		38	80
Training		948	1,272
Total	29,591	23,876	25,038
Savings/yr. over #1		1,129	896
Pay Back Period		6.4 years	16.7 years
Projected rate of return		15.1%	2.9%
Present Value of Savings		10,080	8,004
Investment (subtract)		- 7,259	-14,927
Net Value after 20 yrs.		2,826	6,923

A better representation of these savings is derived by the project rate of return method. This is the discount rate which would make the net present value of the investment equal to zero [Ref. 1].

The net preset value of the investment is the best analysis of the alternative. Here the savings are discounted (at 10%) for the economic life of the investment to present value (in 1974), and matched against the corresponding investment. Twenty years was used as the economic life of the specialized mission helicopters as the lifetime before technology would again suggest replacement. Here, the annual savings were multiplied by the program year discount factors required by DOD instructions concerning economic analyses [Ref. 13]:

Alternative 2. $1.129 m X 8.933 = $10,085,000

3. $ .896 m X 8.933 = $8,004,000

5. Additional Factors Influencing the Mix Selection

The author recognizes the fact that a change from the present mode of operation of helicopters would cause many things to change. A discussion of factors which might be expected to change is given in Appendix C. Among these are considerations of

- Possible savings from the increased life of the MMH fleet.
- The impact on the service caused by the addition of helicopters without additional personnel.
- The subject of dual qualification for helicopter pilots and service personnel.

. Shipboard considerations.

. Weather influences.

. Number of engines and effect on safety.

These would have a considerable influence on any decision regarding choice of helicopters in the future.

D. SHORT-RANGE RECOVERY REPLACEMENT CONSIDERATIONS

At the time of this analysis, a study is underway to select a replacement for the HH-52A which will fill the SRR role. Inasmuch as the helicopter itself has not been selected, there can be no actual operating costs to compare with the alternatives of this analysis. There are, however, basic requirements which should be considered in selecting the new Short-Range Recovery Helicopter (SSR).

Engines	:	twin turbine
Max Gross Weight	:	12,500 pounds or less
Useful Capacity	:	8 people
External Load	:	1000 pounds
Cruise Speed	:	125 Kts.
Dash Speed	:	145 Kts.
Fuel Consumption	:	600 lbs./hr.
Range	:	400 NM
Max Endurance	:	3.5 hours
Price	:	$1.87 m [Ref. 5]

The SRR should completely replace the HH-52A and perform all the missions the retiring helicopter now performs. A major mission area should include all of the shipboard operations such as LE, ice breakers, etc. This comprises the bulk of the missions flown by the BO-105 in this analysis. A comparison of these two helicopters is therefore in order.

The HH-52A has a very limited use outside the Coast Guard. As the aircraft ages, replacement parts become more costly and difficult to acquire. The SRR candidates already enjoy a level of commercial operation at this time, which should assure a better availability of replacement parts throughout the life of the helicopter. This should provide a significantly less costly helicopter to maintain than the H-52.

The BO-105 enjoys a fuel advantage over the proposed SRR (340 #/h4. to 600 #/hr.) but cruises 8 Kts. slower and carries three fewer people. The BO-105 is lighter (5070 lbs. to 12,500 lbs.) and is capable of greater external loads (1984 lbs. to 1000 lbs.). The BO-105 price in 1979 is $972,000, including GSE.

The overall helicopter mission lengths were previously converted by a factor based 43% upon cruise speed differentials, and 57% on a 1:1 basis. The factor to convert BO-105 hours to SRR becomes:

$$.43\ (117 \div 125) + .57 = .972\ .$$

Using 1979 fuel prices, the costs per hour of these helicopters' fuel usage are [Ref. 35]:

$$\text{SRR:}\ \frac{600\ \#/\text{hr.}}{6.6\ \#/\text{gal.}}\ \text{X}\ \$.456/\text{gal.} = \$41.45/\text{hr.}$$

$$\text{BO-105:}\ \ 53\ \text{gal./hr.}\ \text{X}\ \$.456/\text{gal.} = 24.17/\text{hr.}$$

The remaining BO-105 costs per hour total $102.60 (Table VII).

SRR maintenance costs are reasonably expected to be "half those of the H-52" [Ref. 5]. Table VII shows the H-52 maintenance costs to be $91.78/flight hour. This results in an estimated maintenance cost for the SRR of $46/flight hour.

To find when the SRR and BO-105 costs become equal:

$$.972\ (46X) + \$1.87\ m = 126.77X + \$.671\ m$$

$$X = 14{,}612 \text{ BO-105 flight hours.}$$

During the base five-year period, the LOH flew 28,947 hours. It appears reasonable to expect that the SRR candidates' total costs would fall below those of the BO-105 in less than three years.

IV. FUTURE COST AND MISSION EXPECTATIONS

Costs are expected to change. These changes can have a pronounced effect upon the relative costs for different operating alternatives. This chapter considers some of these possibilities.

A. A RISE IN FUEL PRICE

Figure 4 depicts the effects of fuel price increases on the operating costs of the three alternatives. The prices of fuel used in the comparison were the mean of the base years ($.372/gal.), the average price in 1978 ($.443/gal.), and the average prices projected for various future years through 1994. At the outset, these projections seemed less than useful, but as the current petroleum situation of the world becomes less stable, these estimates are more likely to be short-range possibilities and therefore suitable to this analysis.

It is clear that, as the price of fuel increases, each of the SMH alternatives becomes more attractive than alternative 1 because of their lower associated fuel usage rates. Alternative 2, found to be financially acceptable in the first analysis, merely improves in this analysis. Alternative 3, shown to have a net loss of $6,923,000 in value after 20 years in the first analysis continues to be unfavorable. A savings of $1,672,000 per year is required of 3 over 1 before the former becomes attractive financially. The

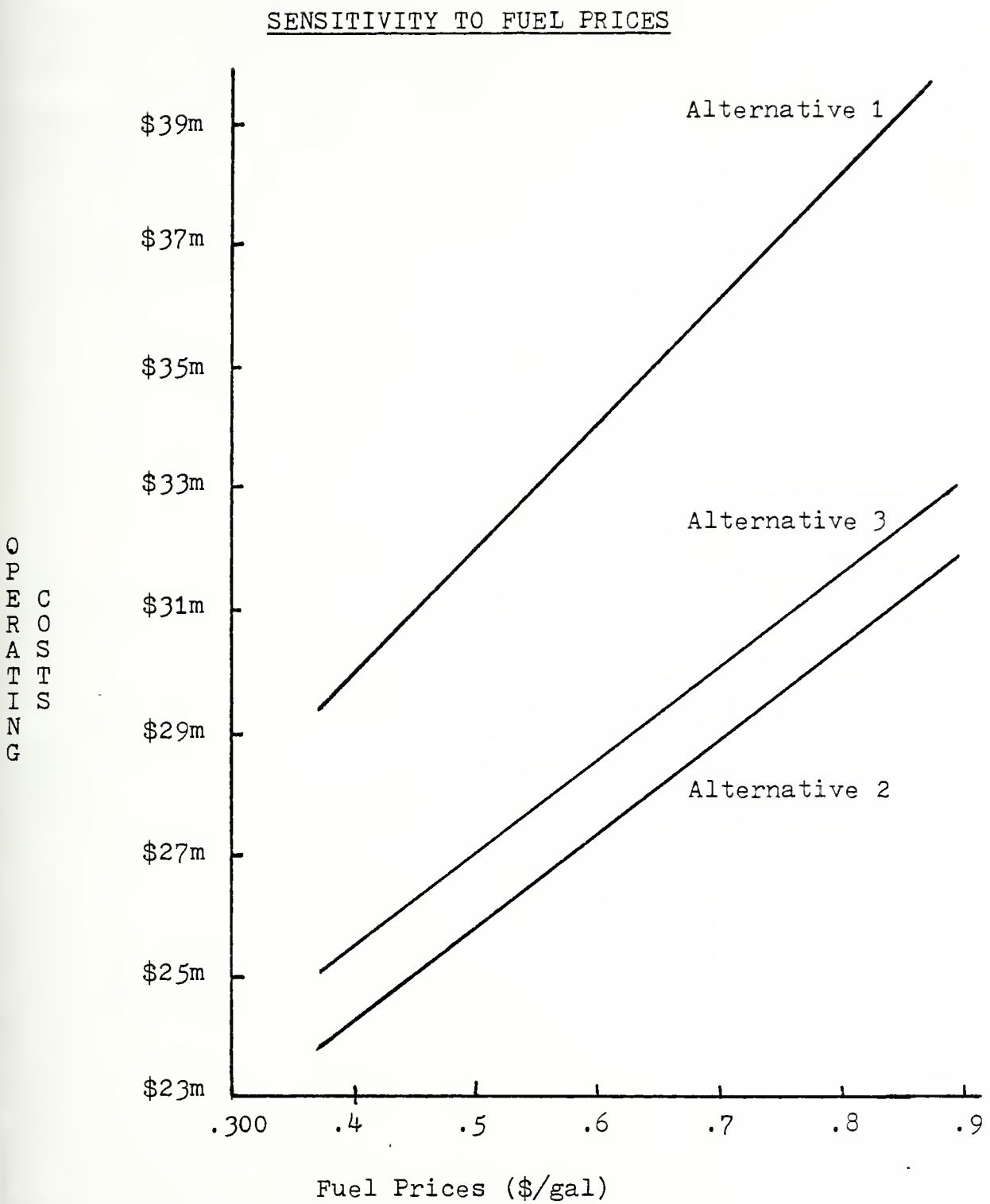


Figure 4. This figure indicates that as fuel prices increase, the operating costs of alternative 1 rises more rapidly than either alternative 2 or 3.

highest benefit this analysis produced for alternative 3 is an annual savings of $1.345m, at an average fuel price of $.867/gal. Fuel prices would have to increase to $1.227/gal. for alternative 3 to break even with 1. Currently, in 1979, this appears to be a distinct possibility.

The analysis of the individual helicopters produced explanations for the differences in operating costs. Below is a summary of the operating cost of each of the helicopters in the alternatives along with the cost of fuel expressed as a percentage of their total operating costs (at a price of $.372/gal. as used in Table VII):

	H-3	H-52	Hughes 500	BO-105
Usage Rate (gal./hr.)	182	61	26	53
Fuel Cost ($/flt. hr.)	67.70	22.69	9.67	19.72
Total Hourly Maintenance Cost ($/flt. hr.)	244.62	114.47	40.47	122.32
% of fuel to total	27.7	19.8	23.9	16.1

It is clear that the costs of operating the BO-105 are affected the least of all the helicopters by the fluctuation of fuel prices. That is, fuel cost addition would represent a higher percentage of total operating cost for each of the other helicopters than for the BO-105's as the cost of fuel increases. This is due to the proportionally greater cost of overhaul for the BO-105. It is also true, however, that the cost of fuel would have to rise to $1.35/gal. before the cost of

one hour of H-52 operation would equal the cost of one BO-105 hour. This would be a 205% increase over the $.443/gal. average fuel price paid in 1978.

This shows that, as fuel prices increase, the MOH becomes more competitive, and thus alternative 3 would appear more attractive. With higher speeds of the BO-105, alternative 3 would then be more attractive than alternatives 1 and 2.

B. PROJECTIONS OF FLIGHT TIME

A linear regression of each mission's total number of hours flown in the base period was performed to determine future trends in each of the next 15 years. A double moving average was also derived to produce another estimate. While these techniques are questionable because of the short data period and the lengthy projection into the future, it was felt that they would be of some interest in analyzing SMH missions in the future.

The strongest coefficients of determination (r^2) were found in LE (.975), and Admin (.864), both strong candidates for specialized mission helicopters. Nearly all mission categories indicate increased activity in the future. Table X presents projections of totals of all the mission areas. These were derived in three ways. The first was from the mean ($\bar{X}$) of the five-year data base period multiplied by 20. The second was derived from a projection for FY 1986 developed from a double moving average of the five-year data base period.

TABLE X

PROJECTION DATA FOR FUTURE OPERATION LEVELS

Mission	$\bar{X}$	r	r^2	Double Moving Average	5-Year Actual Total	FY 1986 Projection: DMA	FY 1986 Projection: LR	X	20-Year Total DMA	20-Year Total LR
SAR	14324	.060	.004	14319	71620	14493	14841	286480	289015	294235
Gen Surv.	929	.483	.233	910	4646	1341	1311	18580	24756	24314
LE	3761	.987	.975	3801	18803	13130	13093	75220	215748	215192
MEP	5686	.890	.792	5596	28432	10298	9602	113720	182902	172468
A to N	2253	.806	.649	2202	11266	3573	4017	45064	64856	71524
Tng.	21976	-.138	.019	22281	109879	19422	20018	439520	401204	410146
Coop	954	.624	.389	966	4771	1465	1587	19080	26741	28579
Polar	1203	.529	.280	1185	6014	1602	1581	24060	30039	29726
Admin	1311	.930	.864	1302	6554	3122	3280	26220	53420	55761
Test	1704	-.107	.012	1733	8620	1520	1535	34080	31420	31649
Ferry	1034	-.141	.020	1126	5175	209	778	20700	8310	14658
Other	680	-.895	.801	677	3401	--	-606	13600	13549	--
Total	55836	.493	.243	56107	279182	69936	70977	111672	1328277	1343843

Table X presents projections of future levels of operations using Averaged ($\bar{X}$), Double Moving Averages (DMA) and Linear Regression (LR) estimates.

This technique gives more weight to the values of the final years of such a period and tends to be reflective of recent trends. This 1986 projection was then assumed to be the average of the final 15-year period, multiplied by 15 and added to the actual number of hours flown in the first five-year period. The third technique was based on a traditional linear regression forecast of FY 1986 level of activities. Again this was assumed to be the average of the final 15-year period, multiplied by 15 and added to the actual hours flown in the data base first five-year period.

The missions, identified in this analysis as possible candidates for SMH assignments, produced increases when compared with the projection based merely on the five-year base average. Applying the distribution of missing hours developed in Chapter II, Table I, to the data of Table X produces the following total flight hours for the SMH:

	74-78	20-Year Est.
100% SMH	39,632 hr.	255,600 hr.
Law Enforcement	9,402	107,800
A to N	5,633	34,500
Coop w/Agencies	2,386	13,700
Ferry	518	5,500
Test	2,778	10,150
Opr. Training	35,405	130,500
Total SMH	95,754	557,750
SMH Missions as % of Total	34.3%	41.8%

C. NEW HELICOPTER MISSIONS

The base period includes all missions that the Coast Guard was responsible for in 1974. The Fisheries Conservation Management Act of 1976 (FCMA) required additional flights to patrol the 200-mile fisheries conservation zone (FCZ) and resulted in a marked increase in the LE hours for both types of MMH's and shipboard hours for the H-52. It is anticipated that flight operations for this mission will continue to increase for a few years and then stabilize [Ref. 18].

Two areas of operations have increased in activity since the end of the base period and therefore are not reflected in the analysis. These are transportation of marine inspectors to oil rigs in the Gulf of Mexico, and pollution patrols in the Second Coast Guard District. Both of these activities have been performed by leased civilian helicopters, generally of the type included in this analysis.

The Outer Continental Shelf (OCS) Lands Act Amendments of 1978 mandate the Coast Guard with the establishment and enforcement of regulations concerning the safe operations of mobile offshore rigs and fixed structures on the outer continental shelf. There are approximately 2400 facilities in the Gulf of Mexico and 20 on the Pacific Coast. These facilities each require an annual inspection, with additional periodic inspections. Starting in FY 1979, light helicopters were contracted from a civilian helicopter leasing company to transport the marine inspectors to the various rigs.

Approximately 3000 hours of leased flight time will be involved in this inspection program each year [Ref. 18].

The helicopters operate from New Orleans, Galveston, Port Arthur, and Morgan City. The present contract calls for three types:

MMB BO-105 : $700/day + $200/flight hour

Bell 206L-1 : $450/day + $ 95/flight hour

Bell 206B : $450/day + $ 90/flight hour

A service charge of 2 to 3% is added to the price for the Department of Interior, Office of Aircraft Service's coordination of the contract.

Each helicopter generally carries two inspectors to a rig and returns them to shore when their inspection is complete. By April, 1979, the usage rate was approximately two hours per helicopter per day over each month.

Of the Marine Safety Zones established in the Second Coast Guard District, five have been evaluated to require airlift services in support of their MEP missions. Generally, it was found that a patrol area of more than 200 miles of river length was more economically covered by leased helicopters than by Coast Guard boat. Each of the five Marine Safety Offices (MSO) authorized for this expenditure has a contract with a local helicopter firm to provide the aerial surveillance necessary for routine and emergency flights. The activity of this contract is outlined below for the period of 1 February 1978 to 1 February 1979 [Ref. 8].

Marine Safety Office	Flights	Flight Hours	Costs
St. Louis, Mo.	37	105	$22,145
Huntington, W.V.	7	30	6,285
Louisville, Ky.	47	198	8,717
Memphis, Tn.	52	123	11,401
Nashville, Tn.	18	70	14,669

The equipment used by each MSO is different from one zone to the next, resulting in the differences in costs incurred. In all cases, however, the helicopters used by the Second District are the same or smaller than those used in this analysis. Nearly all of the MSO's using the leased helicopters expressed pleasure with the arrangement and a desire to continue the contracts. There were some adverse comments about some of the contract helicopters being too small (total of three people capability), and the company's not wanting to fly in "disagreeable weather conditions." The only persistent problem observed in their reports, however, is the lack of communications with the CG personnel in the field by the personnel in the helicopters. Standardized Coast Guard SMH's of the LOH type could fill this role and solve the problems of size and communications.

V. CONCLUSIONS AND RECOMMENDATIONS

The analysis of the three alternative helicopter mixes indicated that a mix other than that existing during the 1974-78 base period might have produced savings. This is not to say that the mixer considered should be considered for the future. It does, however, indicate the value of considering various alternatives for future helicopter procurement.

The addition of the specialized mission helicopter to air stations without additional personnel appears to be efficient enough to offset the additional workload associated with the added aircraft.

Specialized mission helicopters become more cost effective as their usage rates and fuel prices increase. There is little doubt about the fuel prices increasing, and it has been shown that the specialized helicopter missions will continue making up larger portions of Coast Guard flight operations.

There appears to be reasonable evidence that the operation of a specialized mission helicopter would be cost effective in the Coast Guard.

A. RECOMMENDATIONS

It is recommended that a technically-oriented study be conducted into the light helicopter industry to determine which helicopter would be the most suited to the light observation role in the Coast Guard. Further systems analyses of this

sort could be performed upon the actual cost figures of the multi-mission helicopter fleet once the SRR selectee is operational. This would substantiate the assumptions made herein concerning the SRR costs and evaluate how well that helicopter indeed performs the shipboard and other medium observation missions.

APPENDIX A

THE DEVELOPMENT OF COSTS UNDER ALTERNATIVE 2

In this alternative, SMM's, all LOH, were assigned to appropriate air stations. The MMH's required to meet the SAR response were retained at the station. A total of five HH-52's were replaced, however, by these LOH's at stations where more MMH's were assigned than required for SAR (two at Brooklyn and one each at Cape Cod, Miami and San Francisco). The ten H-52's at Mobile are all replaced by the LOH for polar operations.

1. Initial Purchase Price

Thirty-nine LOH's were purchased for this alternative at a price of $179,360, totaling $6,995,000.

2. Non-Recurring Initial Investment

This category includes an initial supply of ground support equipment (GSE) and spare parts, and the travel and per diem costs of sending two people (one pilot and one mechanic) to the factory to be initially trained in the Hughes 500.

The BO-105 literature suggests a value of $12,520 for spares and $6,228 for GSE for each of its helicopters. These are 2.2% and 1.5%, respectively, of the total price used in this analysis. Using these percentages of the total price used for the Hughes 500 ($179,360) yields a cost of $5,919 total

for these items for each helicopter. For the entire alternative, the total cost of GSE and spares would have been $231,000.

It has been estimated that a helicopter training school could train a qualified pilot to fly a helicopter such as the SMH in one week, including travel time [Ref. 24]. Before 18 May 1975, the per diem rates were $25 per day [Ref. 14]. The average distance from each station receiving LOH's to the factory at Culver City, California, is 1778 miles (Table XI). The costs for this portion of the alternative are:

Per Diem: $25/day X 7 days = 175

Travel : $.07/mi. X 2 (1778 miles) = 249

78 people X 424 = $.033m

The total non-recurring investment for this alternative is:

Price	$6.995m
GSE & Spare	.231m
Training	.033m
TOTAL	$7.259m

3. Recurring Costs

This category includes operating costs, GSE replacement, and on-going training of aviation personnel. The MMH equipment replacement rate and training continue, unaffected by this addition. Some amount of MMH GSE replacement and training costs would be reduced, but the amount is difficult

TABLE XI

VARIOUS DISTANCES TO SMH AIR STATIONS

Station	Distance from each Air Station to Training Stations and Helicopter Factories		
	Dallas, TX	Culver City, CA	Philadelphia, PA
Cape Cod	1791	3040	324
Brooklyn	1560	2800	91
Cape May	1488	2807	94
Elizabeth City	1357	2850	255
Miami	1336	2705	1230
St. Petersburg	1112	2481	1089
Houston	259	1542	1546
New Orleans	531	1882	1229
San Diego	1336	120	2761
Los Angeles	1371	15	2738
San Francisco	1735	385	2879
Port Angeles	2149	1200	2854
Astoria	2090	995	2890
Mobile	614	1983	1099
Annette	2808	1859	3454

SOURCE: DOD Official Table of Distances, AR 55-60/NAVSO P2471/AFM 177-135
Data used to determine the distances personnel would -ravel for SMH training.

to assess. Therefore, the more conservative consideration (favoring the null hypothesis) is made.

a. Operating Costs

Table XII presents the flight hours flown in alternative 1 that are designated as available to the LOH. These hours must be subtracted from the total hours flown by the MMH (Table VIII) during the period to arrive at the mix of hours flown under this alternative. This produces:

From H-3 hours:	76,542	
	16,977	
	59,565	hours remaining for H-3
From H-52 hours:	94,301	
	40,722	
	53,579	hours remaining for H-52

These available hours were multiplied by a factor based on the different speeds of the helicopters to arrive at the true number of hours flown by the LOH. Further, as mentioned in Chapter III, some portions of surveillance flights are conducted at slow speeds, or in a hover, where speed differentials make no difference. All of the hours of training and test flights were also subject to this factor. That is, these missions are planned on a time limit rather than a distance to be covered. It was found that during the data base period, training and test flights accounted for approximately 30% of all the flight time. This, coupled with the 15% to 30% factor involved with surveillance flights, produced a factor of approximately 57% of the total flight time

being converted on a one-to-one basis, and the remaining 43% converted by reflecting the speed differentials. These factors are:

H-3 to LOH: .43 (115 ÷ 111) + .57 = 1.015

H-52 to LOH: .43 (86 ÷ 111) + .57 = .903

The hours flown by this mix of helicopters are:

LOH:	from H-3 hours:	16,977 X 1.015 =	17232
	from H-52 hours:	40,722 X .903 =	36772
TOTAL		LOH	54,004
		H-3	59,565
		H-52	53,579

Using the differential hourly costs of Table VII, the total differential operating costs of this alternative become:

LOH:	54004 X 40.47 =	$ 2.186m
H-3:	59565 X 244.62 =	$14.571m
H-52:	53579 X 114.47 =	$ 6.133m
	TOTAL	$22.890m

b. Ground Support Equipment Replacement

For this category, the only differential costs were the additional costs involved with replacing the SMH ground support equipment. The equipment costs 1.1% of the purchase price of $179,360, or $1.973 for each helicopter. With a ten-year life, straight line, no salvage value depreciation, $986 worth of GSE for each of the 39 LOH's was replaced during the base five-year period. This produced a total cost of $38,454 for GSE replacement in this alternative.

c. On-going Training

The number of personnel attending the flight school is based upon the number of aviation officers' billets at each station. This number is derived by the requirements set forth in the Coast Guard Staffing Standards Manual (CG-483). These, in turn, are based upon the SAR response requirement of each station. Table XII contains an indication of the SAR readiness posture of each station. Below is the resulting billet requirements of each station and the number of people attending the LOH flight school each year [Ref. 21].

Air Station	Billets	Attending School
Cape Cod	27	7
Brooklyn	27	7
Cape May	15	4
Elizabeth City	15	4
Miami	15	4
St. Petersburg	16	4
Houston	15	4
New Orleans	27	7
San Diego	27	7
Los Angeles	15	4
San Francisco	15	4
Port Angeles	15	4
Astoria	16	4
Annette	16	4
Mobile	20	5
Total Attending SMH School Each Year =		73

TABLE XII

MMH MISSIONS WHICH WOULD HAVE
BEEN PERFORMED BY SMH

Station	FY 74-78 No. of Helicopters Assumed in Place[1] H3	H52	SMH	SMH Possible Hours H3	H52
Cape Cod	3(1)	3(1)	4	2368	3718
Brooklyn[3]	[3(1)]	5(2)	3	1090	6691
Cape May		3(1)	2		4038
Elizabeth City[3]	3(1)	[3(1)]	3	1061	1948
Miami[2]		4(1)	1		4310
St. Petersburg	4(2)		1	2019	
Houston		3(1)	2		4143
New Orleans	4(2)		2	3399	
San Diego	4(2)		1	2743	
Los Angeles		3(1)	2		3693
San Francisco		3(1)	1		3019
Port Angeles		3(1)	3		4648
Astoria	3(1)		1	2049	
Mobile (deployed)		10(0)	12		4514
Annette/Sitka	3(1)		1	2248	
			39	16977	40722

[1] Numbers in parentheses indicate SAR readiness posture.

[2] Miami actually had five H-52's, so only replace one with SMH.

[3] H-3 assigned to Brooklyn were transferred to Elizabeth City during the period in exchange for Elizabeth City's H-52's.

Table determines the number of multi-mission hours flown by the 15 air stations that must be converted into Specialized Mission Helicopter hours under alternative 2.

Table XI lists the distances from each SMH station to Dallas. That distance times the number of pilots attending the school from stat station produced an average of 1403 miles each way for each pilot. This average distance was used in all cases.

The per diem rate changed twice during the base period. It was $25/day until 5-19-75 when it went to $33/day maximum. On 10-2-76, it increased again to $35/day maximum [Ref. 14]. For this analysis, an average of $31.50/day was used for per diem rates.

The on-going training costs are developed below:

Flight:	$200/hr. X 10 hours	= $2000
Ground:	$ 10/hr. X 18 hours	= $ 180
Per diem:	$31.50/day X 7 days	= $ 221
Travel:	$.07/mile X 2(1403) mi.	= $ 196

Total training = 73 people/yr. X 5 yr. X $2597 = $.948m

The total Recurring Costs, and thus the total differential costs for alternative 2 are:

Operating:	$22.890m
GSE Replacement	.038
On-going Training	.948
TOTAL COSTS	$23.876 m

All costs for Alternative 2 are summarized in Table IX.

APPENDIX B

THE DEVELOPMENT OF COSTS UNDER ALTERNATIVE 3

Under this alternative, 17 single-engine LOH and 22 dual-engine MOH were purchased.

1. Initial Purchase Price

LOH: 17 @ $179,360 = $ 3.049m

MOH: 22 @ $517,180 = $11.378m

Total Purchase Price $14.427m

2. Non-Recurring Initial Investment

The same 1.5% for GSE and 2.2% of the price of the helicopter for spares developed in alternative 2 was used in this alternative. This produced a cost of:

LOH: 3.3% X 179,360 X 17 = $.101m

MOH: 3.3% X 517,180 X 22 = $.375m

Total Ground Support and Spares: $.476m

The initial factory training of SMH personnel was the same as alternative 2 in that there were two people trained for each of the 39 helicopters. A difference may be noted from the difference in location of the two factories (Culver City, California, for the LOH and Philadelphia for the MOH, Table XI). These costs were:

LOH: Travel: 2 X 2069 miles @ $.07/mile = $290

Per Diem: 7 days @ $25/day = $175

34 people X $465 = $.016m

MOH: Travel: 2 X 1496 miles @ $.07/mi = $209

Per Diem: 7 days @ $25/day = $175

44 people X $384 = $.017m

Total Travel and Per Diem $.033m

The total non-recurring investment for this alternative was:

Price:	$14.427m
GSE and Spares:	.476m
Travel and PD:	.033m
TOTAL	$14.936m

3. Recurring Costs

a. Operating Costs

Table XIII presents the flight hours available to the LOH and MOH during the base period in this alternative. The distribution of hours flown by each type helicopter are developed below:

From actual H-3 hours:	76,542	(Table VIII)
	9,699 LOH	(Table XIII)
	13,840 MOH	(Table XIII)
	53,003 Remaining for H-3	
From actual H-52 hours:	94,301	(Table VIII)
	26,298 LOH	(Table XIII)
	17,195 MOH	(Table XIII)
	50,808 Remaining for H-52	

TABLE XIII

MMH MISSIONS WHICH WOULD HAVE BEEN FLOWN BY SMH

IN THE 1974-78 BASE PERIOD

Air Station	No. of Helicopters Assumed in Place (1)				Flight Hours			
					From H-3 Hours		From H-52 Hours	
	H-3	H-52	LOH	MOH	LOH	MOH	LOH	MOH
Cape Cod	3(1)	3(1)	2	2	2368	772	2871	1734
Brooklyn	3(1)	5(2)	2	1	944	594	5628	1753
Cape May		3(1)	2				4038	
Elizabeth City	3(1)	3(1)	2	1	969	178	1920	350
Miami		4(1)		1				4640
St. Petersburg	4(2)		1		2019			
Houston		3(1)	2				4143	
New Orleans	4(2)		2		3399			
San Diego	4(2)			1		3704		
Los Angeles		3(1)	2				3693	
San Francisco		3(1)		1				3065
Port Angeles		3(1)	2	1			4005	1139
Astoria	3(1)			1		4110		
Annette/Sitka	3(1)			1		4482		
Mobile (deployed)		10(0)		12				4514
TOTALS	24	37	17	22	9699	13840	26298	17195

(1) Numbers in parentheses indicate SAR readiness posture.

This table shows the number of multimission hours flown by the 15 air stations that must be converted into Specialized Mission Helicopter hours under alternative 3.

Using the speed differential factors developed in Appendix A, the following hour conversion factors are developed:

H-3 to LOH: .43 (115 ÷ 111) + .57 = 1.015
to MOH: .43 (115 ÷ 117) + .57 = .993

H-52 to LOH: .43 (86 ÷ 111) + .57 = .903
to MOH: .43 (86 ÷ 117) + .57 = .886

The hours flown by this mix of helicopters were:

LOH:	from H-3 hours:	9,699 X 1.015 =	9849
	from H-52 hours:	26,298 X .903 =	23751
		TOTAL LOH	33,600
MOH:	from H-3 hours:	13,840 X .993 =	13738
	from H-52 hours:	17,195 X .886 =	15236
		TOTAL MOH	28,947
		H-3	53,003
		H-52	50,808

Using the differential hourly costs from Table VII, the total differential operating costs of this alternative become:

LOH:	33,600 X 40.47 =	$ 1.360m
MOH:	28,947 X 122.32 =	$ 3.544m
H-3:	53,003 X 244.62 =	$12.966m
H-52:	50,808 X 114.47 =	$ 5.816m
	TOTAL =	$23.686m

b. Ground Support Equipment Replacement

The replacement costs were determined to be:

LOH: 1.1% X $179,360 X .5 X 17 = $.017m

MOH: 1.1% X 517,180 X .5 X 22 = $.063m

Total GSE Replacement Cost = $.080m

c. On-going Training

The number of personnel attending the flight school is based upon the number of aviation officers' billets at each SMH station, and the type of helicopter in use there. The distribution of SMH's was such that approximately half of the pilots attend the school for the LOH and half for the MOH. The on-going training costs are developed below:

Flight:	LOH:	36 X 200 X 10 =	$ 72,000
	MOH:	37 X 375 X 10 =	$138,750
Ground:		73 X 10 X 18 =	$ 13,140
Per Diem:		73 X 31.50 X 7 =	$ 14,339
Travel:		73 x .07 X 2(1403) =	$14,339
Total Training = 5 years X			$254,907/year = $1.272m

The final year total Recurring Costs, and thus the total differential costs, of this alternative were:

Operating:	$23.686
GSE Replacement:	$ .080m
On-Going Training	$ 1.272m
Total Costs	$25.038m

All costs for alternative 3 are summarized in Table IX.

APPENDIX C

FACTORS OTHER THAN COST AFFECTING HELICOPTER SELECTION

Appendix C contains discussions of the following:

- Possible savings resulting from the increased life of the helicopter fleet.
- The impact of the addition of helicopters without the addition of personnel.
- Dual qualification of pilots and service personnel.
- Shipboard considerations.
- Weather influences.
- Number of engines and safety

Aircraft Usage Rates: The Effect on Savings

A summary of the annual usage rates under the tree alternatives is presented below:

	Alternative 1	2	3
H-3	638	496	442
H-52	449	290	275
LOH	-	252	358
MOH	-	-	239

The usage rates of the MMH in alternative 1 are below the Coast Guard norms of 650 hours for the H-52 and 700 hours for the H-3 [Ref. 32]. The addition of the LOH and MOH in alternatives 2 and 3 reduce the MMH rates even further. The effect of this reduced rate on the MMH's would be to extend their calendar lives. The reduced number of MMH flight hours below the levels

of alternative 1 should allow for more maintenance time available and improved operational availability. Alternatives 2 and 3 both provide a reduction in the number of hours required of each MMH remaining in service after the replacement of 15 multi-mission helicopters by specialized mission helicopters. Inasmuch as alternative 3 achieves the greatest reduction in MMH hours and yet maintains a reasonable rate in the SMH hours, it is the favored alternative here.

Impact of Added Helicopters without Personnel Action

A critical assumption is that the SMH's would be placed at a station without any change being made to the station's personnel allowance. Four stations, Cape Cod, Brooklyn, Miami, and San Francisco, were able to reduce their number of MMH assigned by at least one (Brooklyn by two) and continue to meet their SAR responsibilities. The personnel who were assigned to the stations for the displaced MMH's continued to be assigned for the SMH. These stations, therefore, were less affected by the addition of helicopters. The H-52's at Mobile were totally replaced by the SMH's, causing no personnel shortage problem there. The remaining ten stations which received SMH's under alternatives 2 and 3 would indeed have had to maintain extra helicopters without additional personnel.

This situation is partially overcome by the fact that the SMH requires a reduced crew (one pilot and no enlisted compared to the two pilots and two crew in the H-3, and one pilot and one crewman in the H-52), freeing personnel to perform maintenance or other required collateral duties at the station.

The specialized mission helicopters also require less maintenance per flight hour. Below is a summary of the estimated hours of local maintenance (both scheduled and unscheduled) required for each helicopter [Ref. 40]:

Hughes 500:	.5 hr./flt. hr.
BO-105:	.9 hr./flt. hr.
HH-52A:	3.2 hr./flt. hr.
HH-3F:	4.6 hr./flt. hr.

Each aircraft at an air station requires daily inspections, and the addition of an aircraft would add to this task.

The maintenance man hours associated with each of the alternatives were developed by referring to Tables VIII, XII, and XIII.

The San Diego totals were developed below as an example. The factors for converting H-3 hours to LOH and MOH hours developed in Appendices A and B were used (i.e., H-3 hours flown by LOH X 1.015 for LOH hours, and H-3 hours flown by MOH X .993 for MOH hours). These hours were then multiplied by the local man hours summarized above.

Alternative		1	2	3
Flight Hours:	H-3	11,938	9,195	8,234
	LOH		2,784	
	MOH			3,678
Man Hours:	H-3	54,915	42,297	37,876
	LOH		1,392	
	MOH			3,310
Total		54,915	43,689	41,186
Savings over 1			11,226	13,729
Savings per day			6.15	7.52

The man hours saved in the five-year base period of each alternative over alternative 1 could be used to perform these additional daily requirements, or channeled to other tasks about the station. In the San Diego example, there would have been six to 7.5 man hours per day freed by the addition of one SMH to the existing MMH in the five-year period.

Another solution to this problem would be to increase billets along with the addition of the specialized mission helicopters. This solution would be costly and was not included in this analysis. It was felt that the increased productivity of the SMH coupled with the reduced man hour requirements sufficiently offset this personnel problem.

Dual Qualification

The Coast Guard has been making strong efforts to have all aviation personnel qualified and required to fly or maintain only one type and model of aircraft. The major reason for this policy is that there would be no cause for confusion between the operation of two models of helicopters in an emergency situation if only one set of these habits were formed for only one aircraft. The placement of SMH's at stations in addition to the MMH already there would reasonably require a number of pilots and mechanics to be "dual qualified" -- that is, qualified in both the MMH and SMH. It is felt that by limiting the SMH to basic daylight, VFR operations and continuing the current professional training of all MMH crewmen, this would not be a serious problem.

Several stations continue dual qualification of pilots where two types of fixed-wing or rotary-wing aircraft are assigned and a portion of the personnel are qualified in both. Further, it is not uncommon for a permanent change of station to take a crewman from one type of aircraft to another. These difficulties are addressed by continuing training where the possible confusing situations are identified and trained for. This quality of training is currently performed in the Coast Guard. It is felt that the dual qualification situation should be recognized and, if properly addressed, will not pose a significant problem.

Shipboard Considerations

At the present time, the Coast Guard performs all its shipboard flights with the HH-52A. It has been pointed out that this aircraft has all the problems associated with large sophisticated helicopters without their benefits when operating aboard ship [Ref. 9]. That is to say that the H-52 is too large to adequately hangar aboard any ships other than ice breakers, yet it has only one engine and limited electronic gear for surveillance and navigation.

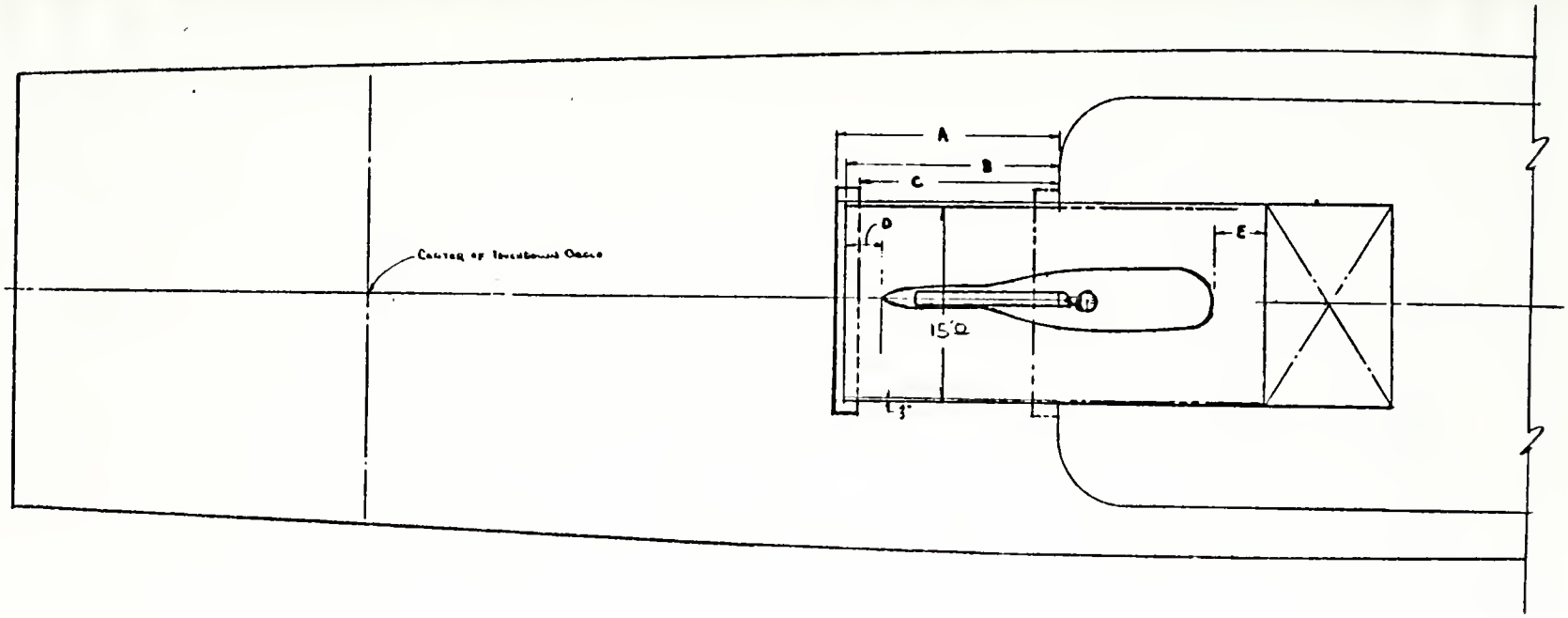
The SMH's in both alternatives 2 and 3 have features that are superior to the H-52 in at least some respects. The BO-105 has two engines and is capable of IFR flight beyond the control of the ship to which it is attached. Both the MBB BO-105 and Hughes 500 have been determined to fit inside feasible hangars aboard the 378 WHEC Coast Guard cutters (the type of ship generally utilized for Alaskan Waters Law

Enforcement Patrols -- ALPAT). Figure 5 is a diagram representing the various clearances associated with the Hughes 500 and BO-105 within these hangars. The figure is included in a memo from the Chief, Office of Engineering at Coast Guard Headquarters concerning several small helicopters aboard Coast Guard vessels. The memo further stated that relative to the Hughes 500 and BO-105:

> "Although the total weight of the helicopters and their hangars is more than the present weight of the HH-52A, it will not substantially reduce the stability of the 378 WHEC." [Ref. 6].

These facts indicate that both of these helicopters possess the benefits of the small helicopters and the BO-105 also has the benefits of the sophisticated helicopters with its navigation capabilities and second engine. At the present time, a LORAN-C unit is available for approximately $20,000 that could be adopted to a light twin-engined helicopter. It weighs approximately 25 pounds [Ref. 41]. This would greatly improve any helicopter's independent navigation and assist in pin pointing a suspected regulation violator's position.

If a helicopter is not able to navigate independently of the vessels, it places severe limitations upon the range of the helicopter from the ship. As long as the ship can determine the helicopter's position on radar, it is considered within a safe distance. This is 25 miles or less, leading some commanding officers to question the effort of launching the helicopter at all. Clearly, independent navigation would be beneficial for a helicopter involved in shipboard operations. The MOH in this analysis has this ability while the LOH does not.



	Hughes 500D	Boeing MBB BO-105	Bell 206B Jet Ranger II
A	18.5 Ft	18.5 Ft	21.5 Ft
B	16.5 Ft	16.5 Ft	19.5 Ft
C	16.0 Ft	16.0 Ft	19.0 Ft
D	1.0 Ft	2.0 Ft	2.0 Ft
E	1.0 Ft	3.0 Ft	2.5 Ft

Figure 5. The clearances provided various light helicopters by a hangar aboard Coast Guard 378 WHEC are shown.

Questioning the value of the embarked helicopter concept is not universal, however. The comment by the Commanding Officer of the CGC Morganthau seems to sum up the appropriateness of helicopters embarked on FCMA enforcement vessels.

> "The helo does more to increase the effectiveness of my ALPAT operations than any other resource. The major constraints are helo down time and weather.... I find that weather was not as much a problem as I had feared. True, there are days you don't fly...but, by and large, those are the days you don't board either." [Ref. 10].

The weather is indeed a factor in shipboard operations. Helicopter launching and retrieving operations are limited by pitch and roll of the vessel, precluding flight if the seas are too rough [Ref. 20]. The SMH candidates are both skid equipped which could increase the pitch and roll limits. These skids would make handling on deck much more difficult than for the wheeled H-52, however.

Traditional weather conditions of ceiling and visibility restrictions are critical as well. The Shipboard-Helicopter Manual (CG-419) specifies weather limits for various operations. The roles filled by the LOH aboard ship would fall under the category requiring a minimum of 500-foot ceiling and one-mile visibility. This could conceivably be flown by a single piloted helicopter, but the limits of both the equipment and the single pilot would soon be reached. The addition of instrument capability and second pilot greatly increases the ability of the helicopter to operate in marginal weather.

A final, and possibly the major, effect of weather on shipboard operations is the action of the environment upon the

helicopter while on board the ship. Without exception, the feature most often desired by shipboard helicopter operators is that the helicopter must be able to be hangared to protect it from the salt and weather effects while it is not flying. Corrosion is a major problem throughout Coast Guard Aviation. Nowhere is corrosion so prevalent as on the flight deck of a ship. Both the SMH's in this analysis have been shown to be compatible with feasible hangars on major Coast Guard ships.

The requirements of a hoist in SAR would be the reason for having a MMH aboard an icebreaker. In the data base period, only 73 hours of the 4514 hours flown by helicopters embarked on ice breakers were for SAR. There are no figures to determine how many of these missions required the hoist, but the total is only 1.6% of the total hours flown by ice breakers' H-52's. This level of operations seems low enough to consider the use of SMH in the ice breaker mission.

Consideration must be given to the operation of single vs. dual engine helicopters offshore in the shipboard missions. It has been felt that single-engine helicopter operations were not desirable and that the reliability of two engines in these operations would make for safer conditions. A recent study, conducted for the Naval Safety Center, indicates that the number of engines a helicopter model has does significantly affect its accident rate [Ref. 4]. The accident rate is a measure of overall safety, beyond engine reliability. While these results are statistically based upon only two Navy models, the H-1 and H-2, it seems reasonable to infer that

the same safety measurements could extend to the helicopters used in this analysis. Therefore, the twin-engine BO-105 should be considered over the single-engine Hughes 500 for shipboard and extended offshore roles where the occasion of an engine failure would cause a much greater risk to the crew.

APPENDIX D

ANALYSIS OF THE LIGHT OBSERVATION HELICOPTER ROLE, EXCLUDING SHIP OPERATIONS AND OFFSHORE PATROLS

Appendix C indicates that the LOH is less suitable in shipboard and offshore patrol operations than either the MOH or SRR. A possible fourth alternative is thereby indicated in which the specialized mission helicopters are only of the light observation type, but are precluded from shipboard and offshore patrol operations. This alternative is similar to alternative 2 with the exception that allocation would be only for the marine pollution patrol (MP) and with consideration for proximity to overhaul facilities.

Table XIV presents the distribution of helicopters under this fourth alternative and the specialized mission helicopter hours flown by the multi-mission helicopter during the base period. It is noted that this possibility results in only 14 stations receiving 27 LOH's.

Using the procedures developed in Appendix A, these hours convert to:

LOH:	from H-3 hours:	19658 X 1.015 =	17,212
	from H-52 hours:	32130 X .903 =	29,013
Total		LOH	46,225
		H-3	59,584
		H-52	62,171

Using the differential hourly costs from Table VII, the total differential operating costs of this alternative become:

TABLE XIV

MMH MISSIONS WHICH WOULD HAVE BEEN FLOWN BY SMH

	FY 74-78 No. of Helicopters Assumed in Place[1]			SMH Hours Flown by MMH	
	H-3	H-52	SMH	H-3	H-52
Cape Cod	3(1)	3(1)	4	2368	2718
Brooklyn[3]	[3(1)]	5(2)	3	1090	6480
Cape May		3(1)	2		4038
Elizabeth City[3]	3(1)	[3(1)]	3	1061	1948
Miami[2]		4(1)	1		2125
St. Petersburg	4(2)		1	2019	
Houston		3(1)	2		3785
New Orleans	4(2)		2	3399	
San Diego	4(2)		1	2724	
Los Angeles		3(1)	2		3393
San Francisco		3(1)	1		3019
Port Angeles		3(1)	3		4624
Astoria	3(1)		1	2049	
Annette/Sitka	3(1)		1	2248	
			27	16958	32130

[1] Numbers in parentheses indicate SAR readiness posture.

[2] Miami actually had five H-52's, so only replace one with SMH.

[3] H-3 assigned to Brooklyn were transferred to Elizabeth City during the period in exchange for Elizabeth City's H-52's.

This table shows the number of multi-mission hours flown by the 14 air stations that must be converted into Light Observation Helicopter hours under restrictive alternative.

LOH:	46,225 X 40.47 =	$ 1.871m
H-3:	59,584 X 244.62 =	$14.575m
H-52:	62,171 X 114.47 =	$ 7.117m
	Total	$23.563m

The ground support equipment replacement costs for this alternative are:

.011 ($179,360) X 27 ÷ 2 = $26,635 .

The number of personnel attending the flight school is reduced in this alternative to 68 with the reduction of Mobile. The costs for this training of the alternative are:

68 x 5 x $2597/year = $882,980

The total recurring costs of this alternative are:

Operating:	$23.563m
GSE Replacement:	$ .027m
On-going Training:	$ .883m
Total Costs	$24.473m

The initial investment for this fourth alternative is $179,360 each for 27 helicopters, or $4,843,000. The ground support equipment and initial spares costs are:

.033 ($179,360) X 27 = $159,810

The initial factory training of two personnel for each of the 27 LOH's is:

54 X $424/person = $22,896 .

The total non-recurring investment for this alternative is:

Price:	$4.843,000
GSE and Spares:	$ 160,000
Training:	$ 23,000
Total	$5.026m

The annual savings of this alternative over alternative 1 is $1,099,000. This produces a payback period of five years. The 20-year net present value of the project is:

(8.933 X 1.009m) - $5,026,000 = $3,987,000 .

APPENDIX E

CAPE COD H-3

Mission	1974	1975	1976	1977	1978	Total
SAR	618	705	653	436	616	3028
General Surveillance				8	5	13
Law Enforcement	30	42	61	58	104	295
Marine Pollution	284	136	143	203	129	895
Aids to Navigation	106	152	157	175	483	1073
Operational Training	444	345	603	486	506	2384
Coop With Agencies	16	15	46	7	18	102
Polar						
Admin.	31	96	75	58	74	334
Test	48	44	55	45	90	282
Ferry		38		7	8	53
Misc. Operations	34	7		3	2	46
Yearly Totals	1611	1580	1793	1486	2035	8505

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

CAPE COD H-52

Mission	1974	1975	1976	1977	1978	Total
SAR	370 (25)	476	352 (7)	301 (21)	343 (37)	1842 (90)
General Surveillance	1	17		16	7 (10)	41 (10)
Law Enforcement	22 (53)	5 (119)	28 (166)	56 (180)	63 (250)	174 (768)
Marine Pollution	329 (12)	170 (3)	173 (10)	297 (10)	399	1368 (35)
Aids to Navigation	77	55 (5)	121	190	419	863 (5)
Operational Training	553 (2)	624 (12)	856 (5)	686 (19)	840 (8)	3559 (46)
Coop With Agencies	21	20	15	12	47	115
Polar						
Admin.	33 (1)	22 (2)	23	70	64 (19)	212 (22)
Test	35	33	37 (1)	34 (1)	67	206 (2)
Ferry		35	23		23	81
Misc. Operations	47	56	5	1	1 (2)	110 (2)
Yearly Totals	1488 (93)	1513 (141)	1633 (189)	1663 (231)	2273 (326)	8570 (980)

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

BROOKLYN H-3

Mission	1974	1975	1976	1977	1978	Total
SAR	365	467	554	50		1436
General Surveillance	3	5	23			31
Law Enforcement	29	114	291	9		443
Marine Pollution	87	114	208	7		416
Aids to Navigation	11	12	15	13		51
Operational Training	392	487	556			1435
Coop With Agencies	19	32	52			103
Polar						
Admin.	27	63	34	2		126
Test	35	57	77	3		172
Ferry	8	1	6			15
Misc. Operations	7	16	9			32
Yearly Totals	983	1368	1825	84		4260

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

BROOKLYN H-52

Mission	1974	1975	1976	1977	1978	Total
SAR	187	275	223 (2)	581 (3)	849 (39)	2115 (44)
General Surveillance	169	255	287 (7)	398	322	1431 (7)
Law Enforcement	35	47	34 (96)	128 (142)	387 (397)	631 (635)
Marine Pollution	331	419	455	622	804 (4)	2631 (4)
Aids to Navigation	18	32	33	89	159 (4)	331 (4)
Operational Training	595	829	790	849 (3)	1055 (20)	4118 (23)
Coop With Agencies	27	20	10	29	49 (3)	135 (3)
Polar						
Admin.	30	58	21	86 (2)	329 (3)	524 (5)
Test	41	72	54	64 (1)	62 (2)	293 (3)
Ferry		20	16	28	8	72
Misc. Operations	57	61	15	6	49	180
Yearly Totals	1491	2088	1936 (105)	2880 (151)	4065 (472)	12461 (728)

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

CAPE MAY H-52

Mission	1974	1975	1976	1977	1978	Total
SAR	541	463	437	356	529	2326
General Surveillance	3	1	7	18	24	53
Law Enforcement	8	10	2	39	51	110
Marine Pollution	447	404	326	318	490	1985
Aids to Navigation	60	25	25	47	60	217
Operational Training	860	920	924	706	673	4083
Coop With Agencies	6	16	9	48	14	93
Polar						
Admin.	33	46	17	17	10	123
Test	49	43	44	35	44	215
Ferry	5	1	14	3	5	28
Misc. Operations	35	12	15	4	35	101
Yearly Totals	2047	1941	1820	1591	1935	9334

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

AS E. CITY H-3

Mission	1974	1975	1976	1977	1978	Total
SAR				950	1391	2341
General Surveillance				30	2	32
Law Enforcement				24	43	67
Marine Pollution				197	219	416
Aids to Navigation				175	253	428
Operational Training				346	420	766
Coop With Agencies				13	22	35
Polar						
Admin.				53	50	103
Test				31	38	69
Ferry				6		6
Misc. Operations				11	15	26
Yearly Totals				1836	2453	4289

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

AS E. CITY H-52

Mission	1974	1975	1976	1977	1978	Total
SAR	381	596	783	106		1866
General Surveillance			9			9
Law Enforcement	11	1	5 (27)			17 (27)
Marine Pollution	175	141	260	11		587
Aids to Navigation	186	159	141	14		500
Operational Training	711	846	599 (1)	5		2161 (1)
Coop With Agencies	21	14	40			75
Polar						
Admin.	82	71	120			273
Test	31	42	52	5		130
Ferry						
Misc. Operations	345	172	132			649
Yearly Totals	1943	2042	2141 (28)	141		6267 (28)

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

SAVANNAH H-52

Mission	1974	1975	1976	1977	1978	Total
SAR	493 (9)	499 (1)	509 (8)	319 (21)	485 (6)	2305 (45)
General Surveillance		1	13	9	4	27
Law Enforcement	15 (22)	9 (86)	58 (259)	188 (227)	194 (76)	464 (670)
Marine Pollution	18	134 (3)	185	116 (38)	184 (21)	637 (62)
Aids to Navigation	16	37	19	17	48	137
Operational Training	913	643	609 (3)	526 (3)	605 (1)	3296 (7)
Coop With Agencies	49	52	39	24 (1)	18	182 (1)
Polar						
Admin.	17	27	35	26	56	161
Test	46	47	39	29	32	193
Ferry		24	9	7	14	54
Misc. Operations	29	32	35	2	19	117
Yearly Totals	1596 (31)	1505 (90)	1550 (270)	1263 (290)	1659 (104)	7573 (785)

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

MIAMI H-52

Mission	1974	1975	1976	1977	1978	Total
SAR	883 (6)	681 (24)	757 (62)	507 (26)	766 (39)	3594 (157)
General Surveillance				1	6	7
Law Enforcement	19 (279)	19 (414)	95 (690)	109 (442)	88 (33)	330 (2155)
Marine Pollution	212	56	109 (1)	172 (10)	263	812 (11)
Aids to Navigation	5		5	5	6	21
Operational Training	971	1007 (19)	1149 (35)	682 (6)	940 (10)	4749 (70)
Coop With Agencies	13	16 (1)	7	18	18	72 (1)
Polar			20			20
Admin.	23	27 (1)	55	40 (2)	53	198 (3)
Test	45	34 (1)	120 (1)	86 (3)	97 (3)	382 (8)
Ferry	18	59	35	15	29	156
Misc. Operations	76	37	20	2	1	136
Yearly Totals	2265 (285)	1936 (460)	2372 (789)	1637 (489)	2267 (382)	10477 (2405)

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

ST. PETE H-3

Mission	1974	1975	1976	1977	1978	Total
SAR	1509	1454	1597	1375	1375	7310
General Surveillance	2				10	12
Law Enforcement		12	212	226	334	784
Marine Pollution	37	21	79	138	101	376
Aids to Navigation	27	61	70	35	40	233
Operational Training	1302	1160	1187	262	933	4844
Coop With Agencies	17	152	52	27	47	295
Polar						
Admin.	64	101	77	53	28	323
Test	54	68	79	50	76	327
Ferry	18	6	33	12	25	94
Misc. Operations	25	23	41	6	14	109
Yearly Totals	3055	3058	3427	2184	2983	14707

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

PUERTO RICO H-3

Mission	1974	1975	1976	1977	1978	Total
SAR	952	964	986	769	837	4508
General Surveillance		9	4		4	17
Law Enforcement		220	146	276	419	1061
Marine Pollution	344	379	229	243	157	1352
Aids to Navigation	80	183	71	54	49	437
Operational Training	813	584	636	393	647	3073
Coop With Agencies	57	56	122	48	33	316
Polar						
Admin.	69	173	193	160	224	819
Test	67	45	72	53	96	333
Ferry			104		45	149
Misc. Operations	1	3	18		4	26
Yearly Totals	2383	2616	2581	1996	2515	12091

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

HOUSTON H-52

Mission	1974	1975	1976	1977	1978	Total
SAR	252	387 (74	575 (21)	506 (8)	516 (7)	2236 (110)
General Surveillance		1	4	2	1	8
Law Enforcement		3 (23)	49 (114)	56 (11)	68 (208)	176 (356)
Marine Pollution	234	467	463	474	512	2150
Aids to Navigation	10	16	8	39	12	85
Operational Training	556	698	877	627 (2)	625	3383 (2)
Coop With Agencies	34	9	43	13	26	125
Polar						
Admin.	2	25	20	12	32	91
Test	28	31	21	30	49 (3)	159 (3)
Ferry	25	53		46	15	139
Misc. Operations	9	33	33	8		83
Yearly Totals	1150	1723 (97)	2093 (135)	1813 (21)	1856 (218)	8635 (471)

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

CORPUS CHRISTI H-52

Mission	1974	1975	1976	1977	1978	Total
SAR	409 (11)	322	343 (6)	306 (8)	358 (4)	1738 (29)
General Surveillance						
Law Enforcement	1	3 (4)	10 (91)	5 (43)	23 (344)	42 (482)
Marine Pollution	171	130	357	297	260	1215
Aids to Navigation	1	2	7	10	5 (2)	25 (2)
Operational Training	572	530	1027	727 (3)	615	3471 (3)
Coop With Agencies	4	8 (3)	14	18	49	93 (3)
Polar						
Admin.	17	2	26 (1)	11	28	84 (1)
Test	26	30	39 (1)	39	36	170 (1)
Ferry	18	59	67	47	38	229
Misc. Operations	15	11				26
Yearly Totals	1234 (11)	1097 (7)	1890 (99)	1460 (54)	1412 (350)	7093 (521)

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

NEW ORLEANS H-3

Mission	1974	1975	1976	1977	1978	Total
SAR	731	1266	1399	1046	1339	5781
General Surveillance	3	66	5	70	2	146
Law Enforcement				94	107	201
Marine Pollution	117	293	308	259	341	1318
Aids to Navigation	9	4	48	41	7	109
Operational Training	623	670	865	691	695	3544
Coop With Agencies	12	27	24	43	43	149
Polar						
Admin.	48	98	110	86	181	523
Test	28	30	74	53	97	282
Ferry	21		31	7	15	74
Misc. Operations	13	32	23	3	1	72
Yearly Totals	1605	2486	2887	2393	2828	12199

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

DETROIT H-52

Mission	1974	1975	1976	1977	1978	Total
SAR	689	591	668	434	500 (1)	2882 (1)
General Surveillance	129	152	103	116	130 (93)	630 (93)
Law Enforcement		8	11		21	40
Marine Pollution	195	247	268	120	138	968
Aids to Navigation	6	3	27	14	39	89
Operational Training	509	782	745	671	732 (1)	3439 (1)
Coop With Agencies	47	72	141	98	135	493
Polar				2		2
Admin.	55	23	45	49	68	240
Test	40	33	33	38	44	188
Ferry	16		38	6	22	82
Misc. Operations	26	22	22	16	5	91
Yearly Totals	1712	1933	2101	1564	1834 (95)	9144 (95)

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

TRAVERSE CITY H-52

Mission	1974	1975	1976	1977	1978	Total
SAR	384	338	424	248	256	1650
General Surveillance	138	88	29	29	21	305
Law Enforcement		4		2		6
Marine Pollution	16	4	31	3		54
Aids to Navigation	72	44	76	126	141	459
Operational Training	659	714	762	668	605	3408
Coop With Agencies	43	23	39	13	71	189
Polar						
Admin.	10	36	31	10	30	117
Test	21	14	15	14	24	88
Ferry	36					36
Misc. Operations	22	9	24		7	62
Yearly Totals	1401	1274	1431	1113	1155	6374

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

CHICAGO H-52

Mission	1974	1975	1976	1977	1978	Total
SAR	216	317	386	239	232	1390
General Surveillance	26	26	47	74	65	238
Law Enforcement						
Marine Pollution	272	323	294	255	314	1458
Aids to Navigation	1	16		4	11	32
Operational Training	611	443	521	426	509	2510
Coop With Agencies	15	20	18	28	52	132
Polar						
Admin.	13	6	23	42	26	110
Test	33	43	33	21	21	151
Ferry	40	28	17	23	44	152
Misc. Operations	13	21	32		4	70
Yearly Totals	1240	1243	1371	1112	1277	6243

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

SAN DIEGO H-3

Mission	1974	1975	1976	1977	1978	Total
SAR	813	709	816	492	462	3292
General Surveillance	3	2	1	1	5	12
Law Enforcement	14	98	130	366	353	961
Marine Pollution	216	159	232	322	347	1276
Aids to Navigation	24	13	22	26	25	110
Operational Training	1127	1229	1381	790	724	5251
Coop With Agencies	32	69	29	41	15	186
Polar		6	10	2	1	19
Admin.	29	17	35	26	56	163
Test	44	45	38	48	46	221
Ferry	123	49	14	73	45	304
Misc. Operations	3	14	59	33	34	143
Yearly Totals	2428	2410	2767	2220	2113	11938

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

LOS ANGELES H-52

Mission	1974	1975	1976	1977	1978	Total
SAR	561 (5)	472	498 (1)	407 (3)	512	2450 (9)
General Surveillance	16 (12)	12	6	6	4	44 (12)
Law Enforcement	22	22 (5)	20 (45)	194 (118)	202 (119)	460 (287)
Marine Pollution	292	225	307	351	469 (1)	1644 (1)
Aids to Navigation	8	9	17	7	28	69
Operational Training	564	583	811	453	525	2936
Coop With Agencies	13	28	18	11	45	115
Polar						
Admin.	60	60	48	77	93	338
Test	55	40	31	16	26	168
Ferry		175	16 (1)	142		333 (1)
Misc. Operations	21	1	7	4	14	47
Yearly Totals	1612 (17)	1627 (5)	1779 (47)	1668 (121)	1918 (120)	8604 (310)

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

SAN FRANCISCO H-52

Mission	1974	1975	1976	1977	1978	Total
SAR	703	820	688	454	622	3287
General Surveillance	5	9	11	4	14	43
Law Enforcement	2	16	4	11	13	46
Marine Pollution	442	334	323	233	219	1551
Aids to Navigation	40	59	68	49	61	277
Operational Training	588	679	835	688	826	3616
Coop With Agencies	29	32	43	20	13	135
Polar						
Admin.	23	27	46	70	27	193
Test	63	72	51	48	60	294
Ferry	142	128	62	135	22	489
Misc. Operations	17	40	75	22	36	190
Yearly Totals	2052	2216	2206	1734	1913	10121

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

ARCATA H-52

Mission	1974	1975	1976	1977	1978	Total
SAR				77	162	239
General Surveillance						
Law Enforcement				1	33	34
Marine Pollution				17	150	167
Aids to Navigation				4	16	20
Operational Training				179	750	929
Coop With Agencies				9	15	24
Polar						
Admin.					13	13
Test				10	29	39
Ferry				6	33	39
Misc. Operations						
Yearly Totals				303	1201	1504

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

PORT ANGELES H-52

Mission	1974	1975	1976	1977	1978	Total
SAR	518	535 (1)	451 (5)	375	387	2266 (6)
General Surveillance						
Law Enforcement	48	50	53 (12)	204	142	497 (12)
Marine Pollution	431	335 (11)	284	315	365	1730 (11)
Aids to Navigation	72	203	226	304	383	1188
Operational Training	1010	616 (2)	551	564	687	3428 (2)
Coop With Agencies	9	32	6	23	47	117
Polar						
Admin.	41	41	43	76	133	334
Test	48	121	39	33	41	282
Ferry	136	120	115	152		523
Misc. Operations						
Yearly Totals	2313	2053 (14)	1768 (17)	2046	2185	10365 (31)

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

ASTORIA H-3

Mission	1974	1975	1976	1977	1978	Total
SAR	492	383	370	265	520	2030
General Surveillance	5		2	2	2	11
Law Enforcement	289	465	501	461	345	2061
Marine Pollution	195	201	173	112	148	829
Aids to Navigation	22	42	15	12	8	99
Operational Training	827	751	507	591	771	3447
Coop With Agencies	12	9	24	60	45	150
Polar						
Admin.	15	53	20	43	21	152
Test	46	61	36	44	35	222
Ferry			148			148
Misc. Operations	1	9	1	1	3	15
Yearly Totals	1904	1974	1797	1591	1898	9164

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

NORTH BEND H-52

Mission	1974	1975	1976	1977	1978	Total
SAR		153	330	199	343	1025
General Surveillance				10		10
Law Enforcement		17	46	122 (25)	200	385 (25)
Marine Pollution		13	10	123	266	412
Aids to Navigation		12	40	70	36	158
Operational Training		789	919	755 (11)	981	3444 (11)
Coop With Agencies		4	24	36	19	83
Polar						
Admin.		35	35	61 (1)	24	155 (1)
Test		23	32	21	39	115
Ferry		84	73	168		325
Misc. Operations						
Yearly Totals		1130	1509	1565 (37)	1908	6112 (37)

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

BARBERS POINT H-52

Mission	1974	1975	1976	1977	1978	Total
SAR	410	367	336 (8)	254 (2)	349	1716 (10)
General Surveillance	5			7	9	21
Law Enforcement		6	6 (17)	33 (2)	16 (28)	61 (47)
Marine Pollution	134	101	55	229 (6)	175	694 (6)
Aids to Navigation	67	66	48	162	33	376
Operational Training	701	691	744 (2)	338 (1)	715 (5)	3189 (8)
Coop With Agencies	69	74	90 (2)	110	229	572 (2)
Polar						
Admin.	18	18	25	28	10	99
Test	35	23	34	16	24	132
Ferry						
Misc. Operations	12	7	3	22	4 (1)	48 (1)
Yearly Totals	1451	1353	1341 (29)	1199 (11)	1564 (34)	6908 (74)

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

ANNETTE H-3

Mission	1974	1975	1976	1977	1978	Total
SAR	787	463	493	188		1931
General Surveillance			3	2		5
Law Enforcement	512	486	512	166		1676
Marine Pollution	28	23	2	39		92
Aids to Navigation	606	573	396	128		1703
Operational Training	573	580	684	251		2088
Coop With Agencies	31	26	35	13		105
Polar						
Admin.	34	14	43	38		129
Test	59	55	53	18		185
Ferry	29	134	61	67		289
Misc. Operations	22	23	31	35		111
Yearly Totals	2679	2377	2313	945		8314

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

KODIAK H-3

Mission	1974	1975	1976	1977	1978	Total
SAR	746	597	334	360	609	2646
General Surveillance		5		16	7	28
Law Enforcement	131	105	115	37	107	495
Marine Pollution	230	71	249	205	160	915
Aids to Navigation	397	479	324	402	234	1836
Operational Training	338	648	638	430	699	2753
Coop With Agencies	106	49	63	37	30	285
Polar				9		9
Admin.	54	8	53	37	40	192
Test	54	85	59	39	52	289
Ferry	34	150	8	111	79	382
Misc. Operations	45	48	102	85	24	305
Yearly Totals	2135	2245	1945	1768	2041	10134

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

KODIAK H-52

Mission	1974	1975	1976	1977	1978	Total
SAR			1 (5)	6 (14)	81 (24)	88 (43)
General Surveillance				1	2	3
Law Enforcement			3 (110)	5 (227)	6 (274)	14 (611)
Marine Pollution			(1)	3 (1)	6 (3)	9 (5)
Aids to Navigation				1	4	5
Operational Training			77 (36)	192 (26)	504 (17)	773 (79)
Coop With Agencies			(1)	1		1 (1)
Polar						
Admin.			(2)	1 (5)	11 (5)	12 (12)
Test			11 (2)	22 (1)	21 (2)	54 (5)
Ferry						
Misc. Operations			(2)		1	1 (2)
Yearly Totals			92 (159)	232 (274)	636 (325)	960 (758)

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

SITKA H-3

Mission	1974	1975	1976	1977	1978	Total
SAR				302	752	1054
General Surveillance				4		4
Law Enforcement				219	339	558
Marine Pollution				18	5	23
Aids to Navigation				86	189	275
Operational Training				183	554	737
Coop With Agencies				14	34	48
Polar						
Admin.				48	49	127
Test				6	78	84
Ferry					5	5
Misc. Operations				30	221	251
Yearly Totals				910	2256	3166

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

AR & SC H-3

Mission	1974	1975	1976	1977	1978	Total
SAR		4				4
General Surveillance						
Law Enforcement						
Marine Pollution						
Aids to Navigation						
Operational Training	99	89	54	42	48	332
Coop With Agencies						
Polar						
Admin.	3	7			3	13
Test	197	153	128	89	95	662
Ferry	4	2		18	10	34
Misc. Operations						
Yearly Totals	303	255	182	149	156	1045

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

AR & SC H-52

Mission	1974	1975	1976	1977	1978	Total
SAR	2	2	1	4	7	16
General Surveillance						
Law Enforcement						
Marine Pollution					5	5
Aids to Navigation						
Operational Training	285	162	182	143	152	924
Coop With Agencies						
Polar					2	2
Admin.	1			1		2
Test	254	315	339	198	239	1345
Ferry	8		10	22	111	151
Misc. Operations	23					23
Yearly Totals	573	479	532	368	516	2468

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

CG AVSUPTRACEN H-3

Mission	1974	1975	1976	1977	1978	Total
SAR	7	28	68	35	62	200
General Surveillance	2	1				3
Law Enforcement				2		2
Marine Pollution	17	4	1		3	25
Aids to Navigation						
Operational Training	1079	1184	1252	979	1443	5937
Coop With Agencies	4	4	21			29
Polar						
Admin.	17	11	8	10	7	53
Test	28	40	28	32	23	151
Ferry		40		20	20	80
Misc. Operations	9	22	4			35
Yearly Totals	1163	1334	1382	1078	1558	6515

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

CG AVSUPTRACEN H-52

Mission	1974	1975	1976	1977	1978	Total
SAR	21 (2)	62 (4)	33 (1)	49	149	314 (7)
General Surveillance	289 (3)	199	218	287	237	1230 (3)
Law Enforcement	63 (225)	88 (277)	 (75)			151 (577)
Marine Pollution	9	 (1)	2	46	116	173 (1)
Aids to Navigation		2 (3)	6	2	10	20 (3)
Operational Training	3281 (14)	2915 (26)	3214	2700	2626	14736 (40)
Coop With Agencies	12	11	27 (1)	10	15	75 (1)
Polar	467	317 (50)	343	395	665	2186 (50)
Admin.	25	16	30 (10)	15	16	102 (10)
Test	149	143	140 (1)	96	151	679 (1)
Ferry	69	127	333	46	83	658
Misc. Operations	90	32	44 (1)	91	2	259 (1)
Yearly Totals	4475 (244)	3912 (361)	4390 (89)	3737	4070	20583 (694)

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

CGC WESTWIND H-52

Mission	1974	1975	1976	1977	1978	Total
SAR				(4)		(4)
General Surveillance						
Law Enforcement						
Marine Pollution				(68)		(68)
Aids to Navigation						
Operational Training						
Coop With Agencies						
Polar	(1)	(88)		(117)	(126)	(332)
Admin.						
Test		(2)		(3)	(3)	(8)
Ferry						
Misc. Operations				(29)		(29)
Yearly Totals	(1)	(90)		(221)	(129)	(441)

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

CGC NORTHWIND H-52

Mission	1974	1975	1976	1977	1978	Total
SAR			(22)		(1)	(23)
General Surveillance						
Law Enforcement						
Marine Pollution						
Aids to Navigation						
Operational Training			(15)			(15)
Coop With Agencies						
Polar	(127)		(245)	(265)	(90)	(727)
Admin.			(3)			(3)
Test	(3)				(2)	(5)
Ferry						
Misc. Operations						
Yearly Totals	(130)		(285)	(265)	(93)	(773)

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

CGC GLACIER H-52

Mission	1974	1975	1976	1977	1978	Total
SAR	(9)	(1)	(6)	(2)	(2)	(20)
General Surveillance						
Law Enforcement						
Marine Pollution			(2)			(2)
Aids to Navigation						
Operational Training	(25)	(16)	(9)			(50)
Coop With Agencies		(3)	(1)			(4)
Polar	(238)	(174)	(373)	(204)	(152)	(1141)
Admin.	(6)	(27)				(33)
Test	(6)	(5)	(5)	(2)	(5)	(23)
Ferry			(1)			(1)
Misc. Operations						
Yearly Totals	(284)	(226)	(397)	(208)	(159)	(1274)

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

CGC BURTON ISLAND H-52

Mission	1974	1975	1976	1977	1978	Total
SAR	(2)			(6)		(8)
General Surveillance						
Law Enforcement			(1)			(1)
Marine Pollution						
Aids to Navigation	(28)	(22)				(50)
Operational Training	(19)	(7)		(31)	(8)	(65)
Coop With Agencies	(54)	(80)		(2)		(136)
Polar	(70)	(277)	(277)	(210)	(168)	(1002)
Admin.	(1)	(21)	(3)	(5)		(30)
Test	(5)	(5)	(5)	(7)	(2)	(24)
Ferry	(3)					(3)
Misc. Operations						
Yearly Totals	(182)	(412)	(286)	(261)	(178)	(1319)

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

CGC STATEN ISLAND H-52

Mission	1974	1975	1976	1977	1978	Total
SAR	(8)	(1)				(9)
General Surveillance						
Law Enforcement						
Marine Pollution						
Aids to Navigation						
Operational Training		(5)				(5)
Coop With Agencies						
Polar	(123)	(82)				(205)
Admin.						
Test	(3)	(3)				(6)
Ferry						
Misc. Operations						
Yearly Totals	(134)	(91)				(225)

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

CGC SOUTH WIND H-52

Mission	1974	1975	1976	1977	1978	Total
SAR	(9)					(9)
General Surveillance	(6)					(6)
Law Enforcement						
Marine Pollution	(4)					(4)
Aids to Navigation						
Operational Training	(18)					(18)
Coop With Agencies						
Polar	(107)					(107)
Admin.	(4)					(4)
Test	4					4
Ferry						
Misc. Operations						
Yearly Totals	4 (148)					4 (148)

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

CGC EDISTO H-52

Mission	1974	1975	1976	1977	1978	Total
SAR		(65)				(65)
General Surveillance						
Law Enforcement						
Marine Pollution						
Aids to Navigation						
Operational Training						
Coop With Agencies						
Polar	(83)	(23)				(106)
Admin.						
Test	(1)	(1)				(2)
Ferry						
Misc. Operations						
Yearly Totals	(84)	(89)				(173)

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

CGC POLAR STAR H-52

Mission	1974	1975	1976	1977	1978	Total
SAR						
General Surveillance						
Law Enforcement						
Marine Pollution						
Aids to Navigation						
Operational Training			(2)			(2)
Coop With Agencies						
Polar			(19)		(67)	(86)
Admin.						
Test			(1)		(2)	(3)
Ferry						
Misc. Operations			(19)			(19)
Yearly Totals			(41)		(69)	(110)

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

CGC POLAR SEA H-52

Mission	1974	1975	1976	1977	1978	Total
SAR						
General Surveillance						
Law Enforcement						
Marine Pollution						
Aids to Navigation						
Operational Training						
Coop With Agencies						
Polar					(44)	(44)
Admin.						
Test					(6)	(6)
Ferry					(1)	(1)
Misc. Operations						
Yearly Totals					(51)	(51)

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

CG TOTAL H-3

Mission	1974	1975	1976	1977	1978	Total
SAR	7020	6978	7270	6269	7963	35500
General Surveillance	101	125	38	131	37	432
Law Enforcement	1008	1533	1968	1937	2151	8597
Marine Pollution	1555	1408	1624	1743	1610	7940
Aids to Navigation	1284	1533	1118	1135	1288	6358
Operational Training	7617	7697	8363	5938	7440	37055
Coop With Agencies	306	438	468	302	287	1801
Polar		6	10	10	1	27
Admin.	391	626	648	614	763	3042
Test	660	658	699	511	726	3254
Ferry	236	407	405	322	252	1622
Misc. Operations	160	150	288	207	318	1123
Yearly Totals	20338	21559	22899	19119	22836	106751

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

CG TOTAL H-52

Mission	1974	1975	1976	1977	1978	Total
SAR	7020 (86)	7389 (119)	7898 (154)	5730 (118)	7446 (160)	35483 (637)
General Surveillance	775 (21)	766	725 (7)	978	839 (103)	4083 (131)
Law Enforcement	246 (579)	308 (928)	423 (1727)	1031 (1431)	1507 (2026)	3515 (6691)
Marine Pollution	3704 (16)	3533 (18)	3909 (14)	4002 (132)	5135 (29)	20283 (209)
Aids to Navigation	638 (28)	737 (30)	879	1119	1471 (6)	4844 (64)
Operational Training	13939 (84)	14471 (87)	16403 (116)	12585 (104)	14965 (70)	72363 (461)
Coop With Agencies	410 (54)	449 (67)	598 (5)	520 (3)	861 (3)	2838 (132)
Polar	467 (749)	317 (694)	343 (914)	395 (796)	665 (647)	2187 (3800)
Admin.	483 (12)	540 (51)	646 (19)	690 (14)	1023 (34)	3382 (130)
Test	1003 (18)	1129 (17)	1172 (25)	854 (18)	1106 (25)	5264 (103)
Ferry	513 (3)	913	828 (2)	847	447	3548 (5)
Misc. Operations	825	582	462 (21)	178 (29)	179 (3)	2225 (53)
Yearly Totals	30022 (1650)	31134 (2011)	34286 (3004)	28929 (2645)	35644 (3106)	160015 (12416)

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

CG TOTAL HELICOPTER

Mission	1974	1975	1976	1977	1978	Total
SAR	14126	14486	15322	12117	15569	71620
General Surveillance	897	891	770	1109	979	18803
Law Enforcement	1833	2769	4118	4399	5684	18803
Marine Pollution	5275	4959	5547	5877	6774	28432
Aids to Navigation	1950	2300	1997	2254	2765	11266
Operational Training	21640	22255	24882	18627	22475	109879
Coop With Agencies	770	954	1071	825	1151	4771
Polar	1216	1017	1267	1201	1313	6014
Admin.	886	1217	1313	1318	1820	6554
Test	1681	1804	1896	1383	1857	8621
Ferry	752	1320	1235	1169	699	5175
Misc. Operations	984	732	771	414	500	3401
Yearly Totals	52010	54704	60189	50693	61586	279182

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

CG AVERAGE H-3

Mission	1974	1975	1976	1977	1978	Total
SAR	231	223	228	201	249	1132
General Surveillance	3	3	1	4	1	12
Law Enforcement	33	49	62	62	67	273
Marine Pollution	51	45	51	56	50	253
Aids to Navigation	42	49	35	36	40	202
Operational Training	251	246	263	190	232	1182
Coop With Agencies	10	14	15	10	9	58
Polar						
Admin.	13	20	20	20	24	97
Test	22	21	20	16	23	102
Ferry	8	13	13	10	8	52
Misc. Operations	5	6	9	6	10	36
Yearly Totals	669	689	717	611	713	3399

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

APPENDIX E

CG AVERAGE H-52

Mission	1974	1975	1976	1977	1978	Total
SAR	125 (2)	124 (2)	126 (2)	87 (2)	110 (2)	572 (10)
General Surveillance	13	12 (1)	12	16	13 (1)	66 (2)
Law Enforcement	4 (10)	5 (16)	7 (28)	16 (22)	22 (30)	54 (106)
Marine Pollution	66	59	62	61 (2)	76	324 (2)
Aids to Navigation	11 (1)	12 (1)	14	17	22	76 (2)
Operational Training	249 (2)	243 (1)	262 (2)	192 (2)	220 (1)	1166 (8)
Coop With Agencies	7 (1)	8 (1)	10	8	13	46 (2)
Polar	8 (13)	5 (12)	5 (15)	6 (12)	10 (10)	34 (62)
Admin.	9	9 (1)	10	10	15 (1)	53 (2)
Test	18	19	19	13	16	85
Ferry	9	15	13	13	7	57
Misc. Operations	14	13	7	2 (1)	3	39 (1)
Yearly Totals	533 (29)	524 (35)	547 (47)	441 (41)	527 (45)	2572 (197)

Notes: 1st number is nonshipboard flight hours.
2nd number is shipboard flight hours.

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